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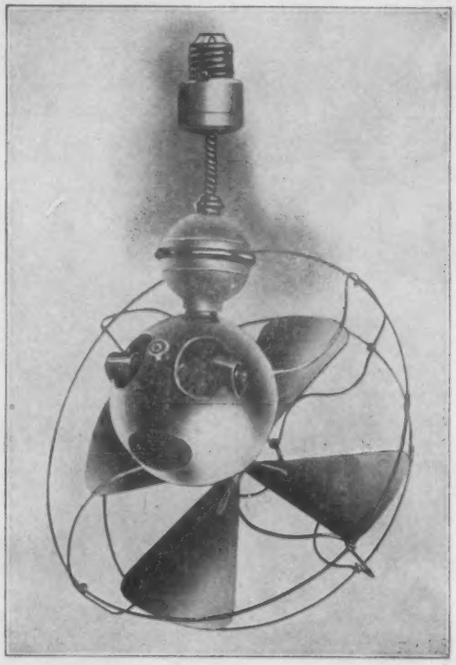

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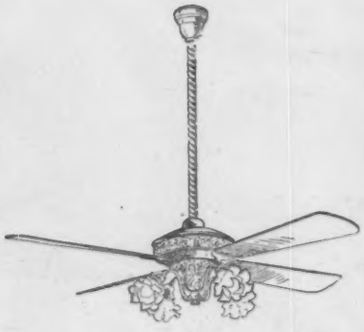

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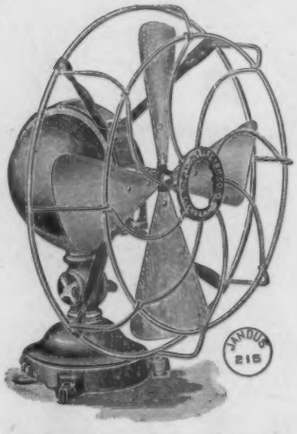

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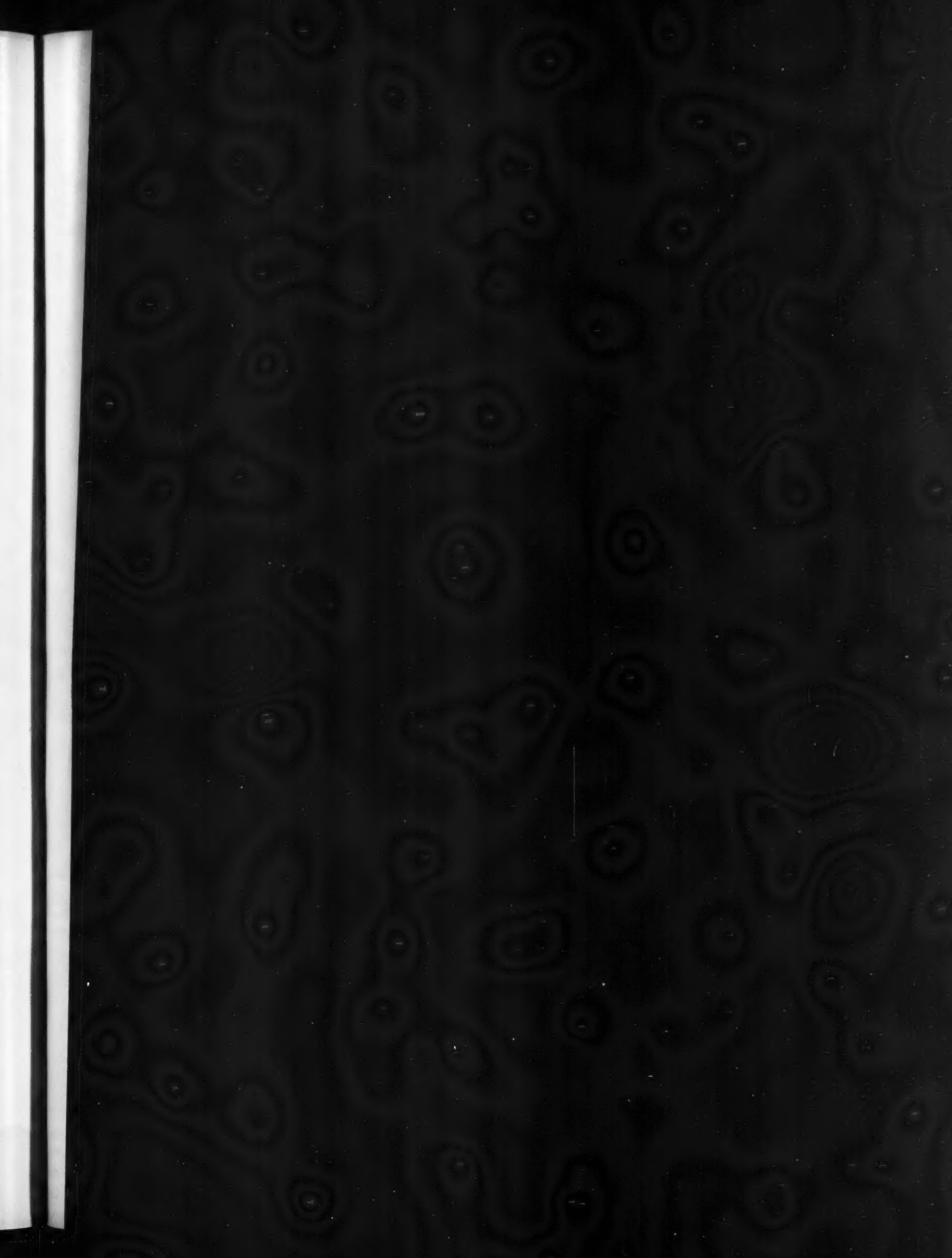

THE

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VOLUME XVIII. SAN FRANCISCO, CAL., MAY 11, 1907 No. 19

HOTEL FAIRMONT

Much has been written of the self-contained completeness of the modern ocean liner, likening it to an up-to-date town in its detail for the material comfort of man. But as the town seems small when compared to the large city so does the liner when contrasted with the spaciousness and magnificence of the large hotel. Just to be launched to the trade of the traveling and comfort-loving public are three hostelries on the shore of San Francisco Bay. These are the Fairmont and St. Francis in San Francisco and the Claremont at Berkeley.

TRELLAGE GARDEN

The power installations in them contain many novel and interesting features that are to be technically described in these columns as the buildings are successively completed. The first of these, not only in time of completion, but also possibly in point of excellence, is the Fairmont, which looms majestically on the summit of Nob Hill, completely covering the block bounded by California, Powell, Sacramento, and Mason Streets. On May 1st of this year the management of the Palace Hotel took over the running of this magnificent institution, having taken an advantageous lease from the Law brothers, to whose indefatigable efforts is due the credit of its speedy rehabilitation after the earthquake and fire of 1906. In replacing what was burned, they profited by the teachings of the fire and utilized every means of making it fireproof. The outside covering of white terra-cotta and granite conceals the massiveness of the steel and reinforced concrete within.

As a preliminary to an extended description of its electrical equipment it is here proposed to give a general view of its interior arrangement, laying particular stress upon the lighting arrangements. Four years were spent in planning its equipment and decoration, and it now stands as an embodiment of the best ideas of leading artists of the world.

There are two ways by which guests may reach the main foyer: either from the Mason Street side by the main

entrance, with which it is on a level, or by tunnel and elevator from Powell and California. The ten floors of the building are served with both passenger and freight elevators for all conceivable purposes.

On entering the vestibule one has a view of the "Trellage Garden," opening from the foyer directly opposite. As will be seen from the first illustration, it is arranged to give the effect of an open-air garden. It consists primarily of three domes, supported on variegated marble columns. The arbor-like effect is supplemented by potted palms and rare exotics. During the day the light comes with a subdued radiance from above through large domes of art glass. At night the main light comes from the pendant globes in the zenith of each dome and from the beautiful side fixtures, whose details are best seen in the picture. This is used as a grill and will accommodate nearly four hundred.

The main foyer contains the office and is the center from which all parts of the hotel may be reached. Here again the main lighting is from above, with auxiliary smaller lights placed on the marble columns for convenience. The hangings of dark red complete the representation of a room of the period of Louis IV. Opening from this on the Mason Street side is the ladies' drawing room and the writing room, the latter equipped with individual desk lights.

The ballroom opens from the north side of the foyer and extends parallel to Sacramento Street, which is overlooked by large windows with beautiful blue hangings. The remaining three sides are finished in large French plate mirrors, interspersed with decorative panels and mural paintings. Brilliant illumination is obtained from the eighteen massive chandeliers, hung from the ceiling by gold link chains.

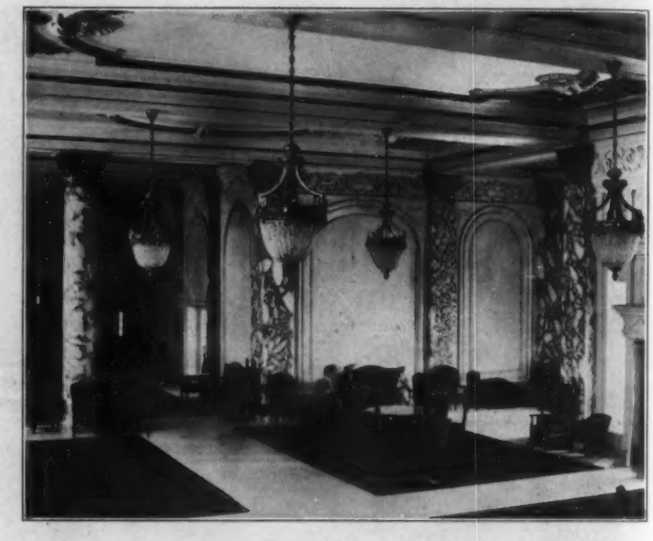
The dining-room gives a fine view of the bay and Berkeley hills on the Powell Street side. This is finished in white and gold in the style of Louis XV. From each ceiling beam is pendant an immense chandelier, giving a general illumination which is individually intensified by electric lights at each table. The fixtures here, as well as throughout the whole building, are in accord with the rest of the decorations. The adjoining breakfast room, finished in gray and white and separated from the dining hall by mirrored doors, has an immense cluster of lights hanging from the center of the ceiling, which is twenty-four feet above the

BALL ROOM

floor.

The halls in the upper floors are well lighted by enclosed globe lamps, each hall having separate switch connections. The room electric light fixtures are in accord with the color scheme.

The upper stories are devoted to the guest rooms, lounging rooms, reading rooms and dining halls, while in the lower floors are placed the kitchens, pantries, servants' quarters, store-rooms, laundry, power-plant, refrigerating plant and ventilating fans. The kitchen is tiled floor to ceiling and is furnished with glass and marble counters and



MAIN FOYER

shelves. Live steam will be used for most of the cooking. As originally planned electric cooking was to be an important adjunct of this department. But the additional equipment brought over by the Palace Hotel management has made this out of the question for the present. The laundry and ventilating plant are run by electricity and will be described in detail, together with the power plant, in a succeeding issue.

SECOND-HAND EDISON LAMP RULING.

A permanent injunction has been issued by the United States Circuit Court, District of New Jersey, restraining William F. McKeon and Joseph Conning of Newark, N. J., from selling second-hand incandescent lamps unless marked "Used and Second-hand." The decision signed by Judge Cross ends a litigation between the General Electric Company and the defendants which had extended over a period of three years. Similar suits were instituted, one against Edward Mills, proprietor of the Newark Electrical Supply Company, and the other against Frederick W. Chase, proprietor of the Lamp Supply Company of New York. Neither of these parties defended, and decrees were therefore taken against them by default.

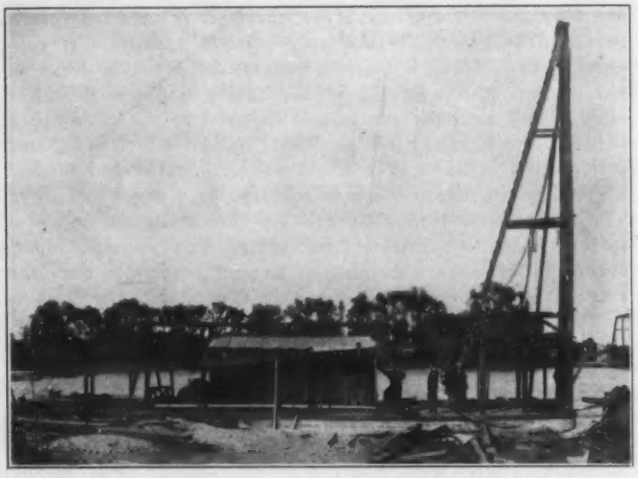
REMOVAL NOTICE.

The Gould Storage Battery Co. will move from their present offices, No. 1 West Thirty-fourth Street, to Nos. 341-347 Fifth Avenue, corner of Thirty-fourth Street, New York City, on June 1.

The Pacific Fire Extinguisher Company has moved its main office to 507 Montgomery Street, San Francisco.

PNEUMATIC PIPE DREDGE.*

A new dredge is being operated on the American river near Sacramento that promises to solve the overflow and reclamation problems of the Sacramento and San Joaquin rivers. It is known as the bed-rock pneumatic pipe dredge. Instead of sucking up sand from the surface of the bed of the river as in the ordinary suction dredge, or bringing up the sand in buckets or shovels, its pipe "jets" its way through the sand at the bottom of the river to bed-rock and lifts the material from there or from any point between the river bottom and bed-rock.



The sand is lifted through the discharge pipe by use of compressed air and water, which are forced from above down several small pipes surrounding the large central discharge pipe into a mixing chamber. The resulting mixture of compressed air and water is then discharged from below into the larger pipe and creates a vacuum at the bottom of the pipe, with the result that the surrounding sand is drawn into the vacuum and forced up through the pipe. In the test made last week the material raised consisted of over 40 per cent of sand.

So successful was the demonstration and so great the quantity of sand raised in proportion to the amount of water that old river men, who have been paying out money all their lives for the building and repairing of levees around their farms, were astounded, and they heralded the new dredge as the salvation of the farming interests in the valleys of the Sacramento and San Joaquin rivers. For the dredge had demonstrated not only that it could lift sand from the very bed-rock of the river at any depth—lift it to any required height above water level and the levees, and discharge it wherever required at a cost considerably lower than any other type of dredge now in use—but it also demonstrated that it could select the materials with which to build levees by bringing up coarse sand and gravel from one stratum of the river bed for the foundation of the levees and the lighter silt for the top covering of the levees from another stratum. The pipe was entirely under control and was raised and lowered at will through the various strata. Furthermore, the cost of constructing the dredge is so small compared with other dredges, and its capacity is so great, that in comparison with the $30,000,000 damage caused by the river floods this year only a small sum would be required to place a chain of these pneumatic dredges at work up and down the river. This would not only build substantial levees and reclaim lands all along the river, but also clean out the river channels and restore navigation to the standard of 1849, at which time boats went up. The pipe can go directly to the bed-rock of the old river channels, prospect for the gold values and bring the sand containing the gold to the surface without first removing the many yards of valueless material and bowlders that overlie the auriferous gravel and black sand. In this way the gold values can be recovered from the river bed while the sand removed can be used in levee building and reclamation work.

*Condensed from Sacramento Union, April 28, 1907.

RATEAU TURBINE COMPRESSOR.

By E. N. Percy.

A new turbine compressor, designed by Rateau, is attracting a good deal of attention. It has a maximum capacity of about 400 horsepower, at 4,500 revolutions per minute, on much the principle of a Parsons turbine, and was designed for purposes of investigation, under the auspices of the "Societe des Turbomoteurs a Combustion," Paris. The trial, as given in the "Schweizerischen Bauzeitung" of November 17, 1906, ran as follows, the compressor being intended for use in connection with a gas turbine:

From the above data, the efficiency and other matter can be worked out. It is likely that smaller sizes of turbine compressors, for smaller pressure, can be built, which will play a very important part in the development of a new type of auxiliary machinery.

Trial of the Rateau Turbo Compressor.

No. of Rev. per min.	Pressure in suction pipe. kilogram	Pressure in discharge pipe. Atmosphere	Barometer millemeters	Air Temperature Centigrade		Heat given to circulating water.	Air Quantities u P S e		H. P.
				Suction	Discharge		cbm sk.	cbm st.	
4030	50.5	4.07	727.5	29.5	67.9	120,722	0.597	5.3	406
4000	103.8	3.75	732.6	27.1	72.5	131,383	0.856	8.	375
4000	137.7	3.50	731.	28.6	78.5	160,626	0.985	9.85	350
4000	164.	3.315	732.6	27.	79.	147,620	1.076	11.84	350
4000	270.	2.52	732.6	25.9	80.		1.381		
4000	261.3	2.417	727.5	30.	87.3	150,000	1.358		
3055	85.	1.32	728.5	23.	50.5	62,000	0.770		
3520	117.	2.06	728.5	25.	65.2	90,000	0.910		
4470	202.	4.78	728.5	26.8	96.	206,212	1.195		
4250							1.13	10.17	400

XI. MODERN CENTRAL TELEPHONE STATIONS.

Lecture Delivered by C. E. Fleager, of the Pacific Telephone & Telegraph Company, on March 13, 1907, to the Students in the Department of Electrical Engineering, in the University of Washington.

In discussing tonight the subject of "Modern Central Telephone Stations," I wish to point out the principal features of the complex equipment going to make up plants installed under modern engineering ideas in the larger cities. In the early days of telephone work the Central office was, perhaps, owing to the undeveloped possibilities and the entire lack of special knowledge on the part of many exchange managers and engineers, so little studied from an engineering standpoint that no type of central office plant had been decided upon as the best adapted type for use. In the last ten years, however, the Multiple Central Energy lamp signal manually operated switchboard has proven itself to be the best adapted to give efficient and good service. It will be this type I discuss.

There are several things in addition to such a switchboard that are necessary for the complete, efficient, and economical working of such a plant. In outline they may be given as follows:

1. The Building.
2. The Protective Apparatus.
3. The Main Distributing Frame.
4. The Intermediate Distributing Frame.
5. The Power Plant.
6. The Switchboard.
7. Special Desks.

My first sub-division (The Building) is one that until recently was probably as much neglected as any, if not more. It was thought that most any building, such as is usually known as commercial quarters, would be sufficient.

However, let us look at a few points not usually found in an ordinary building, which I think will prove that the building must be designed to meet the requirements of the apparatus.

In the first place, the building must be designed for especial protection against fire, as the modern telephone equipment is a vital part of the city's business life, and every precaution should be taken to guard against interruptions to the service. All modern buildings tend towards strictly fireproof structures; so let the telephone building be as modern as possible.

Again, in case of a general fire, such as visited the city of San Francisco, the underground cables need special protection, as these cables are the hardest to connect, being arranged with one hundred pairs of wires having the same color of insulation; while the switchboard cables are arranged with insulation in color codes. This, then, establishes the requirement that the end of the underground cables (termed potheads) should be placed in a fireproof room or vault.

The location of this vault should be between the entrance of the underground cables from the conduit system and underneath the main distributing frame. This location is usually in the basement, as the underground cables can then be brought directly to the pothead rack on the main conduit level, requiring only a simple construction.

The building should be of strong construction, as the weight of the iron and copper going to make up the complete plant is considerable, and, of course, one need only glance at this point to determine that a building designed for the particular requirements will be the most economical.

Again, the amount of copper wire and cable required around the plant can be kept a minimum only by a proper arrangement of the apparatus, which can only be obtained by a pre-determined building arrangement.

In summary then, the building should be designed after the details of the central station equipment have been decided, and with a view of giving the best possible arrangement of such apparatus, keeping in mind proper allowance for growth. Special fire fighting apparatus should be provided, carefully placed and maintained.

The modern protective apparatus usually consists of the carbon airgap, lightning arrester, and the heat coil. The details of assembly differ widely with the different manufacturers, but they may be divided into two general classes:

a. Those in which the heat coils must be replaced with other coils after operation.

b. Those in which the heat coils are self-soldering, requiring only that the position of the coils be changed.

In either division the carbon arrester is used, as this is found to be practically the only efficient arrester. It consists of two blocks of carbon separated by a thin piece of notched mica; one of the blocks having a piece of fusible alloy placed near the center and exposed to the open space between the blocks, the other being solid carbon. The heat coil proper, consists of a small coil of wire wound around a metal bobin, which bobin is soldered to a pin inside of it. The pin extends through the bobin sufficiently to engage a spring clip of the protective mounting. The theory of operation is that when a current of greater amperage than the rated capacity of the coil flows in the circuit, the wire is heated, causing the bobin to become unsoldered from the pin, thereby allowing the circuit to open and the outside circuit to be grounded.

In the case of the self-soldering coils, the pin resolders itself after such action, and it is only necessary to reverse or reset the coil in position, provided the insulation of the wire or the wire itself has not been damaged. The carbon arrester operates on the air-gap principle, and needs no further comment.

The location of this protective apparatus is usually confined to one of three places. It may be at the cable head in a separate room, or on the main distributing frame, either directly on the end of the underground cable wires or on the end of the inside circuit wires. The placing in a separate room at the cable head gives an ideal condition from a fire hazard standpoint, but as this risk is very small and the arrangement bad for the maintenance department, the main distributing frame is usually used. The placing on this frame directly on the underground wires gives a better protection than if placed on the inside circuit side, for the reason that, should the heat coil be blown and the foreign current remain on the underground wire, there is a minimum amount of apparatus charged for exposure to crosses with other circuits.

I have spoken of the main distributing frame, but have given no definition or description of it. It may be defined to be any apparatus that will allow of ready cross connection at will of the underground wires to the wires leading to the switchboard in such a manner that the cross connecting wires can be easily traced or removed. Early frames were of several different forms but experience has brought us to the adoption of an iron frame rack having the protective apparatus arranged vertically on one side and terminals horizontally on the opposite side. A favorite construction is angle irons arranged vertically for the main support and cross bar iron horizontally, connected near their center to the angle irons at the heights of the various horizontal shelves. The protective apparatus is fastened directly to these cross irons at one end and terminals at the other. Longitudinal irons, to properly bind the various uprights together, are arranged at the same height as the horizontal terminals or shelves and carry rings properly insulated and fastened. The cross connecting wires are passed through

these rings, being passed through the particular ring in the same vertical plane as the protector-lug and in the same horizontal plane as the terminal lug which are to be connected together.

The cross connection wire should be insulated with rubber and a flame-proof covering, the gauge of the wire to be at least No. 22 B. & S. The insulation should not be bulky and should be of different colors on the two wires. They should be twisted together with at least one twist in every three inches.

The cables connecting the underground cable side of the main distributing frame with the underground cable potheads should be lead covered, the gauge of the wires to correspond with the gauge of the underground wires. The insulation should be of cotton and silk. In making splice to the underground cable, the joint should be sealed, using the method used by plumbers. The cables should be arranged in some predetermined method to allow of their neat and convenient entrance into the rack and to distribution to the various terminals, allowance for proper growth having been considered.

If the main distributing frame is so large that the average man can not readily reach all terminals when standing on the floor, sliding ladders should be provided. Electric lights should be arranged with special care and should be of such a design as to prevent any possibility of the electric current becoming accidentally crossed with the telephone circuits. Some apparatus for testing defective heat coils and for holding idle coils, carbons, and tools should be furnished. Also a waste can for the disposal of short lengths of cross-connecting wires or defective wire. There should also be a reel for new wire, and stone or soldering iron receptacle. The wire chief will require portable connecting sets for test trunks to this frame.

Taking up the inside circuit at the main distributing frame and following it towards the switchboards, we next come to the intermediate distributing frame. This frame is similar in construction and appearance to the main distributing frame but serves a different purpose. This is the cross-connecting of the various circuits to the multiple jacks (which correspond to the telephone numbers), thereby allowing of the proper bringing together of the various numbers on a party line and the distributing of the traffic load evenly to the different operators. It is this intermediate distributing frame that allows of the changing of the operator's position on which your line is answered without your telephone number being changed.

The same general conditions hold for this frame that hold for the main frame. Where the exchange is not too large the frames are usually placed in the same room. Wire chief's desk and power plant are also usually placed in this room which is named the apparatus room. This allows of the more economical handling of the maintenance of the plant.

Closely associated with the intermediate frame is the relay rack which holds all the line relays. Cabling is extended from these relays to the vertical side of the intermediate frame and from there to the answering jacks located in front of the answering apparatus operators at the switchboard. The horizontal side of the intermediate frame carries the terminals connecting with the multiple jacks.

The power plant of a telephone office equipment, while not of gigantic proportions or of varied styles of machinery, yet it bears some distinctive features not found in any other electric plant. In general, the power plant consists of:

Storage battery.
Electric-driven charging units.
Engine-driven charging units.
Power panels.
Fuse.
Ringing and special apparatus.
Wiring.

The storage batteries are of the usual commercial type, the only distinctive feature being the ample size, considering their load and the unusually large space allowed for sediment. The large size is necessary as it is not common practice to provide a reserve set of batteries, the battery being floated across the bus-bars in parallel with the machine, and it is desired to provide good reserve in case of injury to machines or failure of power. The large space for sediment is provided, owing to the fact that the batteries are not severely used and it is not desired to remove or disturb plates for the cleaning of sediment. The batteries are mounted in the usual manner—lead-lined trays or glass jars being used and double insulation is given in order to prevent any chance of leakage interfering with the telephone line, the receiver being very sensitive to small currents. A separate room should always be provided and be equipped with necessary ventilation and appliances for treating batteries.

The electric-driven charging units vary of course with the available power obtainable in the city, the motor bearing no decisive feature. The generator, however, is of low voltage and comparatively high amperage. Owing to its being footed across the discharge leads, the commutation must be perfect. A low resistance, high impedance coil is often inserted in series with the generator to further prevent any possible disturbance from fluctuation of voltage due to poor commutation.

If the design of the plant requires two voltages, the second voltage being often employed in long-distance talking, a second set of batteries is employed. To economically charge this No. 2 battery which is of smaller size, a second electric-driven machine is employed. It is not considered necessary to have a reserve-charging machine for No. 2 battery as the larger machine can be used should the smaller one be out of order.

Gas engines are the favorite emergency power. Usually this is connected to a generator, the duplicate of the one mentioned above. The gas engine has no special feature but should be reliable and give steady power.

The power panels are usually similar to those in use at central lighting plants, often being of slate. The necessary switches and meters are mounted upon them in the usual manner, possibly the most important switch being the one for measuring the voltage of the various individual storage cells.

The ringing apparatus consists of two sets. One is either belt or direct connected electric motors and generators, the motor being designed for use on the city supply of electric current, the generator to deliver current at a voltage of from 75 to 110. The other set is for emergency use and is designed to have the motor driven by electric current taken from the storage battery. This set is usually a dynamotor. Both generators are usually duplicates of each other. Their size is determined by the size of the exchange.

On these ringing machines are mounted such special apparatus as may be needed for the generation of special signalling currents and tones. A favorite type is to mount the apparatus requiring a large number of interruptions on the same shaft as the ringer armature and gearing a slower speed apparatus to this one. The special signalling currents are used for such information as "The line is busy," "The party doesn't answer," etc.

In connection with the power plant might be mentioned the fuse board. This is a slate panel with rows of fuses mounted in symmetrical order, a special battery bus being supplied for one end of the fuses and battery posts for the other end. The fuses used are of the alarm type, alarm circuits being arranged so that proper signal is given when any fuse is blown. Apparatus allowing of the quick finding of the blown fuse should be supplied and usually consists of lights so arranged that the row in which the blown fuse is located is indicated at once and either a flexible cord and finder permits of locating the individual fuse or the fuse has a small indicator attachment which comes into view

when the fuse is blown. All fuses in the battery circuits as far as possible should be located on this panel.

The wiring found about a telephone power plant follows general practices, the principal point to be noticed being the ample size of the conductors. This is necessary, as the return and battery potentials must be the same relative values at all parts of the switchboard, as very small differences produce noticeable effect in the sensitive telephone receiver.

Our next general subdivision of the central office plant (the switchboard) is probably the most interesting and instructive of all. It certainly is the larger and more complex part. The size and exact details of the switchboard of course will depend upon the size of the exchange. It can be divided into two portions, as:

a. That portion devoted to answering calling subscribers and the completion of their calls either directly to the multiple jacks located in that board or with the assistance of another operator to some other exchange.

b. That portion devoted to assisting some operator at a distant exchange in connecting the calling subscriber in that exchange to the called subscriber in this exchange.

The first portion is called the subscribers' or "A" board, and the second portion the trunk or "B" board. In case there is but one exchange in the city it will not be necessary to have "B" boards until there are more subscribers in the city than can be called from the "A" board by the "A" operator. The surplus in such a case may be placed on a "B" board situated in the same building which would be called a "local 'B' board."

Taking up first the "A" board, we find four decisive divisions of the apparatus:

1st. Apparatus of the operators' positions.
2d. Apparatus of answering jacks.
3d. Apparatus of multiple jacks.
4th. Apparatus of trunk jacks and special.

The operators' positions are usually three to each section of switchboard. The apparatus on a position consists of the cords and plugs, supervisory or clearing lamps, listening keys, ringing keys, call circuit keys, operators' telephone circuit jacks, and other parts. All of this apparatus is mounted in the horizontal portion of the switchboard. The cords are conductors, properly insulated and protected against wear, which forms the flexible connection necessary between the stationary portion of the position apparatus and the plug which is to be inserted into the jacks, thereby making connection with the subscribers' line. The clearing lamps are small incandescent lamps properly mounted in sockets which denote when lighted that the party is either demanding attention or has completed his connection, and same should be disconnected. As there are two of these to each pair of cords the operator is notified of the action of both parties of the connection. The ringing and listening keys are small switches designed to allow the operator to ring the subscriber's bell or connect herself with any particular pair of cords for talking. Each operator's position usually has about twelve to seventeen pairs of cords. The call circuit keys are small switches which allow of the "A" operator connecting herself at will with a "B" operator at some distant switchboard that she may order some subscriber's number which does not appear in front of her connected to a trunk line between herself and the "B" operator.

The operator's telephone jacks are jacks mounted in some convenient place which allows of the operator disconnecting or connecting her head receiver and breast transmitter easily when she leaves or enters the position. Operators are supplied with individual head receivers and breast transmitters.

The answering jack equipment consists of the answering jacks, line lamps, line and cut-off relays, and the necessary terminals and cabling to connect them to the intermediate and main distributing frames for cross connection. The answering jacks and line lamps are usually grouped in rows of ten and placed in the face of the switchboard just above the plug shelf. The jacks and lamps are placed one above the other so that the jack associated with each lamp is easily and naturally determined. The jacks are made in several different styles, almost all of which use hard rubber as the principal insulator. The face of the jack is usually of rubber on which is stamped the jack-numbering and which is attached to a metal framework. Sometimes the frame of the jack is entirely of rubber. Each jack has a cylindrical opening, called the mouth or sleeve, which is of metal. The framework of the plug is made of the same diameter as this opening and makes contact with it as one of the conductors. The other conductors in the plug make contact with springs of the jack when the plug is fully inserted. These springs are mounted from the back portion of the framework of the jack and insulated from each other.

The line lamp is mounted in a suitable socket and in operation is controlled by the line relay. The line relay consists of a small electro-magnet through whose windings an electric current flows when the subscriber's telephone receiver is removed from the hook. This causes a local contact to be made by the attraction of its armature, in turn causing an electric current to pass through the line lamp, making it glow. When the operator answers this call by inserting her answering plug the cut-off relay comes into action, removing or shunting the line relay from the circuit, thereby stopping the line lamp illumination. This cut-off relay is also brought into action whenever a calling cord is inserted in any multiple jack, thus preventing the line lamp from signalling the answering operator when a called subscriber answers his bell. The answering jacks vary in number from sixty to about one hundred and fifty per position, depending on the average load per circuit. Each answering jack appears in one place only.

The multiple jacks are similar in construction to answering jacks, but are mounted twenty per strip. They are arranged in banks of one hundred, numbered from 0 to 99, and are multiplied once in each section; that is, Jack 1 in Section 1, for example, is connected with wires to the terminal on the intermediate distributing frame, from Jack 1, Section 1, to Jack 1, Section 2; Jack 1, Section 2, being located in relatively the same position as Jack 1, Section 1. In similar manner Jack 1, Section 2, is connected to Jack 1, Section 3, and so on throughout the entire switchboard.

With each bank of one hundred jacks is associated on a style casing to the left of the bank a number which represents the hundred and thousand digits of the telephone number. For example, if we wish to find telephone number 7142, we would look on the style casings until we found 71 and then select jack 42 in that bank.

It is possible to place nearly 10,000 multiple jacks in each section so that they can all be reached by the operator. The capacity of the multiple limits the number of subscribers connected to the switchboard, as each multiple jack represents either a telephone number or line, depending upon whether party lines are used or not, and upon the system of numbering in use. In one system each telephone number is given a multiple jack, so that in case of a two-party line two multiples will be connected to the same line at the intermediate distributing frame, and in the case of a four-party line, four multiples will be connected. In the other system where only one multiple jack is connected to each line, the different telephones on a party line each bear the number of the multiple jack and in addition a letter prefix or suffix or similar method of designating to the operators how to ring. In these latter cases the operator's position equipment will be supplied with sets of ringing keys properly marked instead of one key.

The wiring from section to section of these multiple jacks is done by means of cables usually carrying wires for twenty jacks. They are arranged systematically in order to allow of easy finding of any wire giving trouble and to present a neat appearance. The multiple jacks are mounted in the

face of the switchboard so as to leave a small amount of space between the answering jacks and the multiple jacks. In this space is located what are known as trunk jacks, or, in other words, jacks connected to trunk lines leading to other portions of the switchboard, to switchboards in other exchanges, to special desks, etc. These are exactly similar to multiple jacks but have marking or designation strips associated with each row or panel of jacks so that special markings may be used.

The "B" board is in general appearance the same as an "A" board except that the cords found in the horizontal portion are mounted singly instead of in pairs and the answering jack equipment is missing. In this board the trunk lines which we find connected to the trunk jacks in the "A" board are connected to the cords, a designation strip being supplied to allow of the same marking appearing over the trunk jack to be made alongside the trunk cord connected to it.

The operation is this: When the "A" operator desires connection with some subscriber not located in her multiple, she presses the proper call circuit key, thereby connecting her telephone set with the proper "B" operator's telephone set and passes the called telephone number. The "B" operator then picks up some trunk cord that is idle, and after testing in her "B" multiple the desired number, plugs in and rings, advising the "A" operator of the number or marking of the trunk cord. The "A" operator then completes her connection to the proper trunk jack.

The usual lamp signals are supplied on the "B" board but are used in a different manner. One lamp is for the "A" operator to notify the "B" operator when the called subscriber has answered. The completing cord light on the "A" cord works in unison with the subscriber's telephone receiver hook, but the light on the "B" board once in a position denoting that the subscriber has answered does not change, being automatically locked in that position until the "A" operator has disconnected, thus giving the "B" operator the disconnect light. This disconnect signal on the "B" board is controlled by the "A" operator inserting or removing cord from the trunk jack.

The special operating desks consist of wire chief, information, complaint, chief operator, trunk distributing and service observing desks.

At the wire chief's desk all trouble connected with the outside as well as the inside plant is tested and men dispatched to clear the trouble. The desk varies in form, but the essential apparatus is the incoming trunks from the switchboard, test trunks to the switchboard, and distributing frames, and the testing and switching cords.

The incoming and test trunks do not need much discussion, being merely jacks with proper signals and connections. The switching cords are merely two cords connected together very often without signals. The test cords are equipped with listening keys so that the wire chief may connect his telephone set to either cord and may also connect the testing apparatus. There are usually two to five test cords and only one set of testing apparatus per position. The testing apparatus of some standard voltmeter with the proper keys, batteries, and connections, so that resistance measurements may be made to locate the nature and position of the trouble.

The chief operator desk has apparatus for receiving and sending calls to and from the switchboard and for making proper connections through the desk. It also should have a small number of service observing lines, jacks for listening to each operator in the exchange, and instruction circuits to the switchboard. The apparatus allows the chief operator to become familiar with the work of all her operators and to handle such special calls as the public may demand of her.

The information desk is the desk where all information regarding subscribers' numbers, such as is published in the directory, may be given to such subscribers as are unable to obtain a directory, or give information not yet published in the directory. Such other information as the management may desire can be given from the desk. The equipment consists of incoming trunk jacks and signals and answering cords and keys, together with the proper telephone circuits. The desk should also be equipped with card catalogue files.

The complaint desk is similar in equipment to the information desk and is used for receiving and recording all complaints of service or trouble and the segregating and forwarding of service complaints to the chief operator and trouble complaints to the wire chief.

The trunk distributing desk is used for grouping a portion of the trunks incoming from each of several exchanges on to one position when the load is light. Its equipment is usually a few jacks and plugs and cords, the incoming trunks from the distant office to end on one and the trunks going to the "B" board to end on the other.

The service observing desk has equipment for placing of several subscribers' lines on the desk, allowing the attendant to listen on any line when signals show that operator or subscriber is using the line. This allows of the actual service being given to be determined.

In conclusion, a few words about the traffic load curve may be of interest. Our load curve is of similar nature to that of an electric light or street railway plant. Four peaks may be noticed, one from nine to eleven a. m., one from two to four p. m., one from five to six p. m., and one after seven in the evening. In most exchanges the morning peak is the higher, provided it has business telephones to any extent.

The hours vary on different days, but usually will be as given.

THE VICTORIA FALLS POWER TRANSMISSION PROJECT.

According to an official pamphlet recently issued by the British South African Company, who are the promoters of the Victoria Falls Power Company, Ltd., the main feature of the scheme is the generation by hydraulic power of electrical energy at the Victoria Falls and its transmission at 150,000 volts pressure to the Rand—a distance of 700 miles. The initial installation of machinery proposed is for the production of 50,000 horsepower.

As an integral part of the complete installation, the engineers have advised the erection on the Rand of a 24,000-horsepower steam-driven generating station and a system of hydraulic accumulation patented by Mr. Wilson Fox.

The object of the accumulator system is to pump water into high-level reservoirs during times of low demand for power, and to use it for the reproduction of power when required, the capacity of the reservoirs to be adequate for a twelve hours' supply. To do this, necessarily involves additional water turbines and generating plant at the Rand end of the transmission line.

The object of the steam-driven plant is to act as a standby in case of temporary interruption of current from the Falls. At present a tentative suggestion is made to the effect that the company may ultimately adopt three-phase transmission at the pressure of 150,000 volts and a frequency of 12.5 periods, the conductors being carried on steel towers about 60 feet high and spaced 1,000 feet apart.

STATION RECORDS.

Lecture Delivered to Class in Electrical Engineering on February 27, 1907, by Mr. J. D. Ross at the University of Washington, Seattle, Wash.

(Continued from last issue.)

All work orders are made in duplicate, one copy being left in the book for file. In the case of outside work cards the copy kept on file is the original and is made of thinner material to make copying easy. In order that an account of the depreciation and operation of apparatus may be carefully determined, a card index system should be kept, giving the life history of the apparatus from the time it is purchased until it is relegated to the past. These are especially suitable for records of transformers, motors, arc and Nernst lamps and meters. All changes, repair material, and labor can be charged on these cards with very little trouble.

WORK ORDER

THE CITY OF SEATTLE
LIGHTING AND WATER DEPT.

LIGHTING

L. B. YOUNGS
SUPERINTENDENT

No. W. 0 0 DATE ..... 190...

Please do the following:

Charge ..... Amount .....
" .....
Labor .....
Material .....

Signed .....

RENEWAL RECEIPT

Address ..... Name .....

Received of THE CITY OF SEATTLE, LIGHTING DEPARTMENT the following new lamps:

.....2 C. P. .....4 C. P. ..... 8 C. P. .....16 C. P. .....32 C. P., which are to replace .....2 C. P. .....4 C. P. .....8 C. P. .....16 C. P. .....32 C. P. burned out lamps.

.....herewith return ..... C. P. .....C. P. good lamps and in place of them hereby acknowledge receipt of ..... C. P. ..... C. P.

.....

Seattle.....190...

Full information as to location, nature of inspection or service must be given.

Approved:

.....

.....

OFFICIAL TITLE

This statement must be filed with and approved by the head of the department daily.

V. B. 389—5M.

BANK..... **TRANSFORMER RECORD** NO.....

CITY OF SEATTLE, LIGHTING DEPARTMENT

LOCATION .....

POLE NO..... POLE OWNER ..... MAKE ..... FACTORY NO.....

TYPE ..... SECONDARIES { VOLTAGE ..... WIRE ..... OIL FILLED .....

DATE PUT UP..... 190.. DATE TAKEN DOWN..... 190.. PURCHASED..... 190..

DATE MONTH	DAY	YEAR	REMARKS

MOTOR RECORD NO.....

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF MOTOR { MAKE ..... TYPE ..... SIZE ..... H. P., AMP. .....
..... C. VOLTAGE ..... PHASE ..... FACTORY NO. .....
STARTER NO. ..... STARTER MAKE .....
OWNED BY ..... PURCHASED ..... 190..

DATE MONTH	DAY	YEAR	REMARKS

NO.....

ARC LAMP RECORD

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF ARC LAMP { MAKE ..... FACTORY NO. ..... POLE .....
CLASS ..... STYLE ..... FINISH ..... AMPERES .....
PURCHASED ..... 190..

DATE MO.	D	YR.	MAINTENANCE AMT.	MAINTENANCE TROUBLE	DATE MO.	D	YR.	REMARKS

NO.....

NERNST LAMP RECORD

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF NERNST LAMP { TYPE ..... SLG. VOLTS ..... AMP. ..... FINISH ..... CAT. NO. .....
SHADE ..... GLOBE ..... HEAT. CASE ..... BALL .....
PURCHASED ..... 190..

DATE MO.	D	YR.	MAINTENANCE AMT.	MAINTENANCE TROUBLE	DATE MO.	D	YR.	REMARKS

NO.....

METER RECORD

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF METER { MAKE ..... FACTORY NO. ..... TYPE .....
FORM ..... CLASS ..... WIRE, AMP. ..... VOLTS ..... MULT. .....
PURCHASED ..... 190.....

DATE MONTH	DAY	YEAR	REMARKS

ADDITIONAL INSTALLATION. LAMP RECEIPT No. .....

Address ..... Name .....

RECEIVED OF THE CITY OF SEATTLE LIGHTING DEPARTMENT.

.....4 C. P. .....8 C. P. .....16 C. P. .....32 C. P. .....1 Gl. .....2 Gl.

.....3 Gl. .....5 Gl. .....6 Gl. .....Amp. Arcs .....Amp. Arcs .....Amp. Arcs

Lamps, which are to be used only with current supplied from the City's circuits, at above address. The undersigned agrees to return the above number of lamps with glass intact, when the City's service is discontinued; and further agrees to pay for all lamps not so returned, and for all lamps broken, at 30 cents each for 32 C. P. and 20 cents each for 4, 8 and 16 C. P., and for Arcs and Nernst lamps at the market prices for same when lost or broken.

.....

Seattle.....190...

Date_____

Address_____

M_____

Please notify your wiring contractor that the following protective devices are required before City Meter can be installed:

_____ wire main line cutout. _____ wire main line switch.

_____ wire _____ branch blocks. _____ Amp. fuses.

_____

_____ CITY LIGHTING DEPT.

_____ by_____

ORIGINAL INSTALLATION. LAMP RECEIPT No._____

Address_____ Name_____

RECEIVED OF THE CITY OF SEATTLE LIGHTING DEPARTMENT

_____4 C. P. _____8 C. P. _____16 C. P. _____32 C. P. _____1 Gl. _____2 Gl.

_____3 Gl. _____5 Gl. _____6 Gl. _____Amp. Arcs _____Amp. Arcs _____Amp. Arcs

Lamps, which are to be used only with current supplied from the City's circuits, at above address. The undersigned agrees to return the above number of lamps with glass intact, when the City's service is discontinued; and further agrees to pay for all lamps not so returned, and for all lamps broken, at 30 cents each for 32 C. P. and 20 cents each for 4, 8 and 16 C. P., and for Arcs and Nernst lamps at the market prices for same when lost or broken.

_____ _____

Seattle,_____190_____ _____

CITY OF SEATTLE LIGHTING DEPT.

ROUTE_____

CARD_____

ADDRESS_____

NAME_____

ACC'T NO._____ METER_____ AMP._____ VOLTS_____

MULT._____ INSTALLED_____ 190___ MAKE_____

LOCATION_____

YEAR 190___	DAY	READING	DIFFERENCE	MAX METERS NUMBER	MAX METERS READING	CALLED

City of Seattle

Requisition on Storekeeper

No...... *Date*.....*1907*

Municipal Light & Power Plant

Please deliver the following material:

QUANTITY	MATERIAL
For	

Foreman

TOOL SLIP

.....*190*....

Received of

Seattle M. L. & P. P.

*One*_____

_____

Same to be returned or charged to my account,

_____

VA—320—2M-2-05.

I have a number of miscellaneous cards which are mostly self-explanatory. I have grouped these into several groups instead of showing them separately.

The lamp receipts are made out for original and for additional installations. Where a customer supplies his own lamps this is of course unnecessary.

The requisition on storekeeper and the tool slip show our method of keeping the stock room straight. Our stock-keeper also keeps a daily detailed record in a stock book for the purpose.

In meter work we find that customers sometimes have an installation that is not ready for a meter, and we issue a slip stating exactly what is needed from his contractor.

In case customer is not at home a slip is put under the door, giving the time when meter reader will call again. This has also the effect of convincing the customer that the reader has called at the proper time.

The meter test cards are self-explanatory.

The time slips and expense accounts have been mostly copied from the City Engineer's department, and are filled out each day so that the time may be charged to the proper account.

THE CITY OF SEATTLE

LIGHTING DEPARTMENT

DAILY EXPENSE SLIP

OFFICIAL POSITION

.....

.....

For.....190.....

Where and What For	Amount

LIGHTING DEPT.

DAILY TIME SLIP

.....Crew No.....

Foreman.....190.....

NAME	Inst. P. Const.	Inst. P. Oper.	Inst. L.C. Const.	Inst. L.C. Oper.	C. L.C. Const.	C. L.C. Oper.	St. Crt. Const.	St. Crt. Oper.	P. Line Const.	P. Line Oper.	TOTAL TIME
Totals											

Time must be turned in on this slip each day. No time allowed unless on this sheet.

V-B-3-D 1000 080M3CSA 0P00

.....Date.....190....

Do not write on this line.

Mr. J. D. Ross: The following trouble has been reported to me:

At.....*Phone*.....

Customer's name .....

Trouble .....

.....

.....

Signed .....

TEST METER

For.....

At.....

Date.....*No*.....*Reading*.....

Type.....*Amp*.....*Multiplier*.....

Volts	*Rev.*	*Sec.*	*Met. Reg*	*S'd Reg*	*% F*	*% S*

METER AS LEFT

TIME SLIP

LIGHTING

DATE.....190....

NAME.....

POSITION .....

.....DIVISION

Work Order Number	DESCRIPTION OF WORK	Hours	Minutes

THE ABOVE IS CORRECT

Form V. B. 427. 5 M. 11-7-06 SIGNED.....

CITY OF SEATTLE

LIGHTING AND WATER WORKS DEPARTMENT.

Expenses of.....

(Official Position).....

Month of.....

DATE	AMOUNT	ORD. NO.	LID NO.	REMARKS
				Total Amt. for Month, $

I HEREBY CERTIFY that the above amount of.....
expense is a just claim against the City of Seattle.

.....

.....

V. B. 421-B 1-08. 1M.

Quantity of	Material Used	Dollars	Cents
.....	Feet No..... ...Wire.....	.....	.....
.....	Feet No..... .....Wire.....	.....	.....
.....	Feet Twin Cable.....	.....	.....
.....	Wood Pins.....	.....	.....
.....	Iron Pins.....	.....	.....
.....	Wood Steps.....	.....	.....
.....	Iron Steps.....	.....	.....
.....	Glass Insulators.....	.....	.....
.....	Porcelain Insulators.....	.....	.....
.....	.....Circuit Breakers.....	.....	.....
.....	.....Circuit Breakers.....	.....	.....
.....	Brady Cutouts.....	.....	.....
.....	Iron.....Brackets.....	.....	.....
.....	Eye Bolts.....	.....	.....
.....	..... " x....." Bolts.....	.....	.....
.....	....." x....." Bolts.....	.....	.....
.....	....." x....." Lag Screws.....	.....	.....
.....	Feet Rope.....	.....	.....
.....	Rope Cleats.....	.....	.....
.....	.....pin Cross Arms.....	.....	.....
.....	.....pin Cross Arms.....	.....	.....
.....	Cut Washers.....	.....	.....
.....	Cast Washers.....	.....	.....
.....	Cross Arm Braces.....	.....	.....
.....	Junction Switches.....	.....	.....
.....	Fuse Blocks.....	.....	.....
.....	Angle Arm Braces.....	.....	.....
.....	Crosby Clips.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	TIME.....	.....	.....
.....	Hours Foreman.....	.....	.....
.....	Hours Lineman	.....	.....
.....	Hours Repair Men.....	.....	.....
.....	Hours Ground Men.....	.....	.....
.....	Hours Team.....	.....	.....

The trouble slips are important. One point to be noticed is the space for customers' signature. If this is got when a troubleman makes repairs it shows that he is satisfied, and prevents him from misrepresenting or denying that the work has been done.

The contract blanks are so nearly similar in all plants that I shall not touch on this point.

SHOOT TROUBLE

At .....

For .....

Reported ..... *a. m.* *p. m.* ..... *190*....

.....

.....

.....

Delegated to .....

Report .....

.....

.....

.....

.....

.....

Repaired ..... *a. m.* *p. m.* ..... *190*....

Signed .....
Customer

Signed .....
Troubleman

V. B. 449-12-27-06-2M

FILAMENTS FOR INCANDESCENT LIGHTS.

Carbon filaments for incandescent lamps are made either from cotton threads parchmentized by action of sulphuric acid, afterward drawn to uniform cross section and finally carbonized, or from cotton wool dissolved in zinc chloride solution which is forced through a small aperture into alcohol where it sets in the form of filaments. These are heated until carbonized. The latter can stand more current and have a longer life. The latest advance is a filament devised by Professor Parker, of Columbia University, to which the name "helion" has been applied, on account of its sunlike light. It is reported to be a carbon filament impregnated or covered with silicon, of great resistance and durability and capable of soldering its parts together at a break. Selective radiation is claimed for it. It is said that it emits white light at a temperature at which carbon is only red hot.

THE TUNGSTEN LAMP.

The fusing point of tungsten is about 2,500 degrees Centigrade, which enables it to operate at the high efficiency obtained in the tungsten lamp. An 85-candlepower tungsten lamp consumes 105 watts, less than one and one-half watts per candlepower. An ordinary incandescent lamp consumes three and one-half watts per candlepower. The life of the new tungsten lamp is approximately 1,000 hours, and it appears to be equally good on direct or alternating current.

Tungsten does not seem to be ductile, and unites readily with oxygen and carbon at high temperatures. Making a tungsten filament has been a difficult problem, but has been successfully done by several processes.

VALTELLINA ELECTRICAL RAILROAD.

The Valtellina Railroad in Italy is using electric power exclusively for the regular traffic on long distance. The electrical installation was carried out by Ganz & Co., Budapest. The current is three-phase alternating; the line has two parallel overhead wire conductors and has the third phase carried in the rails. The length of the road is 67 miles, of which 30 per cent is in tunnels, and nearly 50 per cent of the full length of the road is composed of curves. The maximum grade is 2 per cent, and the minimum radius is 1,000 feet. The road is laid with 80-pound rails placed on impregnated wooden ties, the rails being bonded with copper at the joints to provide for good electric conduction. The electric locomotives weigh 51 tons and have four motors of 150 horsepower each, using current of 3,000 volts. The ordinary passenger trains consist of one motor car and four to five ordinary passenger cars. The speed is from 40 to 45 miles an hour, which is maintained even on grades up to 1 per cent. The locomotives in freight traffic pull trains of 280 tons with a speed of 40 miles per hour, and 440-ton trains with a speed of 22 miles per hour.

The energy necessary per ton mile has been found to be with full speed on the level from 18 to 20 watt hours and in heavy grades from 34 to 55 watt hours. When starting a train to a speed of 40 miles per hour during a time of two minutes, about 150 watt hours per ton of train weight is necessary. The average energy required measured at the power station is 73 watt hours per ton mile, but in this is included all current used for heating, lighting, for the power required for the railway shops and all losses. At the power station the maximum load is nearly 2,000 kilowatts, but the average load is only 700 kilowatts, slightly more than one-third of the maximum. The cost for the electrical installation is shown in the table below:

Power station	$600,000
Main conductors and transformers....	200,000
Working conductors	360,000
Ten motor cars, each $24,000.....	240,000
Five locomotives, each $20,000.....	100,000
	$1,500,000

The cost per mile is thus about $22,400 for the electrical installation alone. The operation costs for 1904 amounted to $300,000. The passenger fares are those common for express train service in Italy, which is 1.6 and 3.8 cents per mile, respectively, for third and first class. This installation is particularly interesting, as it has proven the practical possibility of using the same train system for electricity as for steam on comparatively long distances. It has proven that electrical locomotives in all respects may replace the steam engines, and that the future of electricity for railroad power generation wherever the power can be had cheaply, that is, where waterpower is available, is secured.—Teknisk Tidshrift.

RECENT ADVANCES IN IRON-ORE SMELTING.

Under the conditions which obtain in most of the settled portions of the world, neither pig iron nor ordinary structural steels can be produced in the electric furnace at a cost to compete with the blast furnace. Under exceptional conditions, where ample water power can be very cheaply developed near the ores, while fuel is very dear, pig iron and steel can be produced profitably in the electric furnace. Harbord estimates that with electrical energy costing $10 per electrical horsepower-year, and with coke at $7 per ton, the two methods are about on an equality. Electrical methods may be practicable in the case of titaniferous ores, or other ores difficult to treat in the blast furnace, if the resulting product possesses any properties which would counterbalance the increased cost. They can also be profitably applied to the manufacture of crucible steel, or other high-grade special steels and ferro-alloys.

FIRST COST OF MECHANICAL vs. CHIMNEY DRAFT.

It is difficult to make a general comparison of the first cost of a chimney with that of a mechanical-draft plant, because most chimneys for power plants are usually put up to obtain a draft from 0.5 to 0.75 of an inch of water, while mechanical-draft systems are seldom installed except to give a draft of at least one inch. It is probable that most chimneys are between 100 and 150 feet high, while a chimney to give a draft of one inch would have to be between 175 and 200 feet high, and the cost of a chimney increases very much as the height is made greater than about 125 feet. Moreover, for a large power plant several small steel chimneys are often put up instead of one large brick chimney, and these chimneys may be of cheap steel construction, so that the cost may be small. While a tall chimney to give a high draft costs more than a low chimney to burn the same quantity of coal under a low draft, a fan to supply air for a given quantity of coal under a high draft costs less than a fan for the same quantity of coal under a low draft. A low draft, however, means a low rate of combustion per square foot of grate surface, and hence a large area of grate in order to burn a given quantity of coal per hour, and it means, also, an almost total inability to burn coals of very low grade; while a high draft means a rapid combustion per square foot of grate surface, and hence a small grate to burn a given quantity of coal per hour, and also the ability to burn cheap coals of low grade.

A chimney to give a draft of 0.75 of an inch must be about 125 feet high, and one to give a draft of 1.5 inches would probably have to be at least 250 feet high. The cost of the higher chimney would be so very much greater than that of the lower that few engineers would recommend it solely because of the greater draft which would be maintained with it. In the case of a mechanical-draft apparatus, however, the apparatus to supply the air for the combustion of a given quantity of coal per hour under a maximum draft of 0.75 of an inch would be larger and cost more than the apparatus to supply the air for the combustion of the same quantity of coal under a maximum draft of 1.5 inches. The diameter of the fan wheel for the higher draft would be about 0.83 of the diameter of the fan wheel for the lower draft, and the dimensions of the engine, assuming it to be direct-connected to the fan, might also be smaller for the higher draft. The work done in running the fan for the higher draft would be twice as great as that for the lower, and hence the running expenses would be almost twice as great, but, even then, the running expenses would be small. Thus, to supply air for the combustion of 5,000 pounds of coal per hour with an economizer under a maximum draft of 0.75 of an inch of water, an induced mechanical draft apparatus would require a fan with a seven-foot wheel; while, to supply air for the combustion of the same quantity of coal under a maximum draft of 1.5 inches, a fan with a wheel six feet in diameter would be more than ample, and a five and one-half-foot wheel would be almost large enough. The seven-foot fan would have to be run at a speed of 195 to 200 revolutions per minute and would require a direct-connected engine having a cylinder six inches in diameter with an eight-inch stroke; while the six-foot fan would have to be run at a speed of about 325 revolutions per minute, and an engine having a cylinder six inches in diameter and an eight-inch stroke would be more than ample for it, because of the greater number of revolutions made per minute. The dimensions of the engine are based upon the supposition that the boiler pressure would be at least 100 pounds. This example illustrates the curious anomaly in regard to the difference between a chimney and a mechanical-draft plant. In the case of the chimney the consideration of the first cost makes the engineer keep the chimney as low as possible and get along with as low a draft as possible; while, in the case of a mechanical-draft apparatus, the consideration of first cost makes the engineer keep the draft as high as possible. The running expense is what makes the engineer keep the draft given by a mechanical-draft apparatus low, but the running expense is usually more than offset by such advantages as the ability to burn cheaper fuel and to maintain a hotter fire in the furnace, thus securing that more perfect combustion for poor fuels which always attends a high draft. It is seldom that a mechanical-draft system is installed to give a draft no greater than would be likely to be given by a chimney, and hence the higher draft capable of being obtained with the mechanical-draft apparatus must be carefully borne in mind when considering the first cost. It is possible, of course, to put up one or more cheap chimneys for a power plant and make the cost of them less than the cost of a properly-designed mechanical-draft system, but it is probable that in most cases a lined, self-supporting steel chimney or a brick chimney will cost considerably more than a mechanical-draft apparatus capable of furnishing air for the combustion of the same quantity of coal per hour, and further, capable of giving a higher draft than the chimney. When, because of local conditions, it is necessary to discharge the gases of combustion at a considerable height, 100 to 150 feet above the ground, the mechanical-draft apparatus plus the chimney for discharge of the gases, may cost even more than a chimney alone that would be capable of furnishing at a low draft the air required for the combustion of the coal; but if the draft required be at all high, it is probable that, even under these circumstances, the cost of a suitable mechanical-draft apparatus would be less than that of the chimney.

SUMMER SCHOOL FOR ARTISANS AT THE UNIVERSITY OF WISCONSIN.

The seventh annual session of the Summer School for Artisans, held under the direction of the College of Engineering of the University of Wisconsin, begins June 24th, and continues for a period of six weeks. Courses of study are offered in the following subjects: Engines and Boilers.—Lectures and laboratory courses covering the theory, construction, management and testing of steam engines, boilers, gas engines and gas producers, refrigerating machines. Applied Electricity.—Lectures and laboratory courses covering the theory of direct and alternating current dynamos and motors, the operation and method of testing electrical machinery, batteries, transformers and other apparatus, photometry, and calibration of instruments. Mechanical Drawing and Machine Design.—Elements of applied mathematics, courses in mechanical drawing and machine design adapted to the preparation of the students. Materials of Construction, Fuels and Lubricants.—Lectures on the properties of materials accompanied by laboratory tests; lectures on fuels and lubricants with laboratory tests on the heating value of coals and efficiency of lubricants. Shop Work.—Practice with hand tools, wood and metal working machinery, and in blacksmithing and pattern making. Manual Training.—Lectures and laboratory courses adapted to the requirements of manual training teachers. The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work so that the student may take advantage of all the preparation he has obtained. This school offers to those unable to take a regular four years' course an opportunity of obtaining a working knowledge of the methods of testing, and the use of instruments, together with such theoretical principles in each case as the nature of the subject and the preparation of the student may permit.

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

MISCELLANEOUS.

BESSELECTRIC CIGAR LIGHTS.

For us on circuits of not over 125 V. A small igniting coil imbedded in a porcelain disc and provided with a suitable cut-out switch and handle. Approved Jan. 3, 1907. Manufactured by

The Besselectric Light Co., Scranton, Pa.

KNOSTRAIN INSULATING BUSHINGS.

A composition insulating bushing for sockets, rosette-caps, etc., designed for reinforced flexible or ordinary lamp cord. Approved Feb. 7, 1907. Manufactured by

Frank H. Stewart Electric Co., Philadelphia, Pa.

"O. K." ground clamp. A copper band with lug for soldered connections and screws for tightening. In sizes ½ inch to 3 inches. Approved March 13, 1907. Mfd. by

The Pettingel-Andrews Co., Boston, Mass.

STEWART AUTOMATIC, HIGH VOLTAGE CUT-OUT DEVICE.

An iron and slate case enclosing link fuses and automatic switch for short-circuiting the service line, the latter operated by means of magnet in event of excess voltage on line. Approved Jan. 7, 1907. Manufactured by

S. J. Stewart, New Orleans, La.

PANELBOARDS.

N. E. Mfg. Co. 125-250 V.; type A, 2-wire; type B, 2-wire; type C, 3-wire. Approved Jan. 29, 1907. Mfd. by

The Newport Electric Mfg. Co., Newport, Ky.

"Universal." 2-wire, 125 V.; 3-wire, 250 V. For Edison plug fuses, with or without branch circuit switches. These boards have rings formed in the branch bus-bars to serve as receptacles for fuses. Approved Feb. 8, 1907. Mfd. by

J. Lang Electric Co., Chicago, Ill.

PROTECTORS, TELEPHONE.

"Noark." Approved March 4, 1907. Manufactured by

The Johns-Pratt Company, Hartford, Conn.

The H. W. Johns-Manville Co., New York, N. Y., Sole Agents

RECEPTACLE, STANDARD.

"Benjamin," 3A, 250 V. Cat. No. 6B, for outlet boxes, with or without cover. Approved Jan. 10, 1907. Manufactured by

Benjamin Electric Mfg. Co., Chicago, Ill.

G. E. Flush receptacle and plug, 10A, 125 and 250 V. Cat. No. 33,441. Approved Jan. 31, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

P. & S. Cat. Nos. 2371, 02371, 237, 0237, 247, 0247, 1087, 107, 971, 770, 670, 870, 871, 877, 1072, 973, 977, 777 and 577, with removable porcelain ring. Weatherproof types. Cat. Nos. 1160, 1161, 972 and 974, 250 V. Approved Mar. 4, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RECEPTACLE, STANDARD, SUB-BASE.

P. & S. Cat. No. 1162. A round porcelain piece for use with weatherproof receptacles Nos. 1160 and 1161. Approved Mar. 4, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RHEOSTATS.

Ward-Leonard. FF and FB types field rheostats, 50-600 V.; KRE, HRE, KVE and HVE types speed control rheostats, 100-600 V.; BD, SD and IBD types theater dimmers, 125 and 250 V. Also SKE., ESKE, ESVE, SIK, and SVE types motor starting rheostats, 125-500 V. Approved Jan. 14, 1907. Manufactured by

Ward-Leonard Electric Co., Brontzville, N. Y.

ROSETTES, FUSELESS.

Fielding. Cleat, concealed and moulding types. Nos. 433, 435, 436, 437, 438, 441 and 480. Approved Feb. 13, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

"Peru," cleat types. Cat. Nos. 985, 986, 7422 and 7421, with porcelain sub-base; concealed type, Cat. No. 987; porcelain tie buttons, concealed and moulding types, and porcelain tie button and cleat, improved type. Approved Apr. 1, 1907. Manufactured by

Peru Electric Mfg. Co., Peru, Ind.

ROSETTES, LINK FUSE.

M. S. Cleat type. Cat. No. 950. Approved Apr. 9, 1907. Manufactured by

Marshall Electric Mfg. Co., Boston, Mass.

SOCKETS, WEATHERPROOF.

Knowles' porcelain weatherproof socket, 250 V., 50 C. P. Approved Jan. 10, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

P. & S. Pendant style, Nos. 116, 117. Bracket style, Nos. 0116½ and 116½. Approved Jan. 3, 1907. Manufactured by

Pass & Seymour, Solway, New York.

Trumbull porcelain weatherproof socket, Cat. Nos. 978, 250 V., 50 C. P. Approved March 25, 1907. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, COMBINATION CUT-OUT.

"Noark," 61-600A, 250 V. Two and three-pole. An iron box containing standard cartridge fuses, with device for withdrawing fuses from clips when cover of box is opened. Approved Mar. 4, 1907. Manufactured by

The Johns-Pratt Co., Hartford, Conn.

The H. W. Johns-Manville Co., New York, N. Y., Sole Agts.

"Paiste" knife switches with cartridge fuse cut-out extension, 0-30 and 31-60A, 250 V., two and three-wire. Approved Apr. 9, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

SWITCHES, KNIFE.

"Krantz"—all capacities, 125 and 250 V., with or without open-link fuse extensions, front or back connected. Approved Apr. 9, 1907. Manufactured by

H. Krantz Mfg. Co., Brooklyn, N. Y.

"Premo"—all capacities 250 V., 25, 50, 75 and 100A, 500 V., with or without standard cartridge fuse extensions. Approved Feb. 7, 1907. Manufactured by

The Barkelew Electric and Mfg. Co., Middletown, Ohio.

"Trio"—(formerly Tornquist), 25, 50, 75 and 100A., 250 V., with or without standard enclosed fuse cut-out extensions; also 15A., 125 and 250 V., single-pole, double-pole and three-way, single and double throw. Approved Feb. 26, 1907. Manufactured by

Trio Manufacturing Co., Rock Island, Ill.

SWITCH BOX.

"Fancleve." An iron supporting box for surface snap switches, for use with wooden moulding. Approved Apr. 2, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

"Fancleve." A cast-iron conduit switch and outlet box. Approved Jan. 10, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

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Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII MAY 11, 1907 No. 19

EDITORIAL.

SAN FRANCISCO'S INDUSTRIAL FUTURE

It is doubtful if there is a city in the world inhabited by supposedly intelligent people which is in the abominable condition of San Francisco today. It is not the intention of the "Journal" to indicate upon whom the blame should be placed or to take sides in the controversy which has been practically continuously carried on for more than five years in this city between the interests representing labor and the interests representing capital. San Francisco's future, however, is threatened. Its geographical position gives it a tremendous advantage over any other city on the Pacific Coast. It must carry on work in certain lines of business under any and all conditions. These lines of work, however, are purely commercial. A large portion of the entire State of California, either directly or indirectly, has San Francisco for its market and business center. Nevertheless, unless conditions are improved, the position of supremacy, in which San Francisco, notwithstanding the earthquake and fire, stands today as the metropolis of the Pacific Coast, will and must pass to some other city, inhabited and controlled by saner people.

Those interested in engineering and engineering enterprises may well give the situation careful study. The proper remedy must be found and speedily applied. Every citizen of San Francisco, and indirectly every person in the State, must appreciate what the ultimate result will be if the present conditions are allowed to continue. Substantially all of the extraordinary progress of our State, as well as our country, in fact of the entire civilized world, which has taken place during the last decade, and particularly since the revival of industries in the early seventies, has been affected through the adoption of scientific systems, as well as the introduction of universal and cheap transportation. The great economic question of today in every State and in every nation, for all time to come, is, "How shall the industries be most effectively sustained and promoted as a basis for all moral, intellectual and material advancement?"

The answer is that the needful thing is industry scientifically utilized and properly rewarded.

The industrial world is one in which the human hand and brain working to a common end find ingenious mechanical combinations and discover new methods by which the labor assisting machine may be made to do the work of the world more completely, and thus reduce the working time and lighten the labor of the people, permitting the rapid accumulation of wealth in forms of permanent value. The work of agriculture even is beginning to be a world of mechanics, and its people are more and more segregating where they find life most attractive, and they are constantly finding ways of securing for themselves and their children comfort, competence, education and freedom from anxiety as a result of their industry, physical effort and mental ability.

All over the country, however, and especially in San Francisco, there has been developed a serious class prejudice which is preventing the proper co-operation in the work of the human hand and its necessary working partner, Capital, intelligently directed. Within recent years, largely on account of cheap power, San Francisco has had visions of the possibility in the future of becoming a great industrial center. If, however, what the public press indicates is true, namely, that there are now more than twenty-five thousand persons unemployed because of strikes, the attitude which men of affairs must of necessity take cannot result in the future upbuilding of San Francisco as an industrial city.

The impression that the stranger would receive on lower Market Street today should shame every loyal San Franciscan. Two great public utilities—the street railway lines and the telephone system—are both closed down on account of striking employes. About nine thousand machinists are out, shutting down many important machine shops in the city. San Francisco's greatest manufacturing plant—the Union Iron Works—will probably never again be operated as it was a few years ago, when the famous battleship "Oregon" was constructed at these works. In addition, everyone is inconvenienced by the closing down of practically all the laundries on account of labor troubles. Little effective and efficient work is being done in any line, and all construction is costing from twenty-five to fifty per cent more than should be the case on account of the abnormal cost of really efficient labor, as well as material, and all this with no specific reason, except

perhaps that which may be truthfully called class hatred and personal greed.

San Francisco's friends who so nobly stood by her a year ago, and who have repeatedly expressed admiration for the grit shown by her people in the rebuilding of the city, cannot but condemn her for the present situation. Our future is at stake. Whatever the real cause is, it must be removed. One cannot but hope that no matter how serious the present street car strike may be, a permanent settlement will result in the very near future of all of San Francisco's labor and capital troubles.

THE ILLUMINATING ENGINEER.

On Friday evening, May 3d, a large number interested in illumination met at the assembly hall of the Pacific Gas and Electric Co., San Francisco, to organize a local branch of the Illuminating Engineers' Society. The minutes of the meeting are here printed in full, and will be followed in a subsequent issue by an article on the objects of the Association:

Meeting was called to order at 8:30.

Mr. W. J. Miller was elected as temporary Chairman, and Mr. W. H. Crim, Jr., as Secretary.

Mr. Lansingh, manager of the New York branch of the Society, spoke at length on the purpose of this organization, and the method of organizing.

Mr. Barret, secretary of the San Francisco Gas & Electric Co., spoke on the importance of the Society, and urged those present to fill out applications, and induce their freinds of different professions, interested in the subject of illumination, to join.

At the request of the Chairman, the Secretary read the rules governing the various sections of the Society.

Nominations for two managers to be elected were as follows: Mr. Dolliver, Mr. Meyer, Mr. Roach, and Professor Corey. Then a motion was duly made to close the nominations.

Vote by ballot was taken, with the following result: Mr. Corey and Mr. Meyer being elected.

Motion was duly made and seconded that the chair, together with the other officers, appoint a committee for the purpose of increasing the membership of the San Francisco section. The motion was carried.

Mr. Barret and Mr. Marland spoke of the good that would come of the thorough knowledge of lighting, by architects and engineers, in obtaining the proper amount of illumination and still reduce the cost of power to consumers.

The chair called attention to the fact that through discussion on the lighting subject, architects might bring about satisfactory results of making the cost of installation, cost of power, etc., satisfactory to landlord, tenant, and lighting companies alike.

Mr. Lansingh suggested that the first three or four meetings should be taken on simple subjects, such as window lighting and artificial lighting of various rooms of residences.

Mr. Marshall also suggested the necessity of starting on simple lines in discussion, and observation of various kinds of lighting of the city, in order to familiarize the members with the subject.

Motion was duly made and seconded that when the required fifty applications were secured by the officers, the chair should apply to the Council for the necessary data to form the San Francisco section.

Mr. Barret offered the assistance of the clerical department of the S. F. Gas & Electric Co. to assist in sending out notices, etc.

The chair called for a meeting on Thursday, May 16th.

Motion was made and seconded that a vote of thanks be tendered to Mr. Lansingh, Mr. Marshall, and the San Francisco Gas & Electric Co., especially for the use of their assembly hall. The motion was carried.

The meeting adjourned at 10:30.

BOOK REVIEWS.

"Proceedings of the Thirteenth and Fourteenth Annual Meetings of the Pacific Coast Gas Association" contains a record of official business transacted, together with a number of interesting papers and discussions on problems of gas engineering. These have been printed from time to time in the columns of this journal, but are here collected together in compact and convenient form. The papers read include: "Gas Arcs," by W. M. Kapus; "The Spangenberg Meter," by E. C. Jones; "House Piping," by George Kirk; "The Compression and Transmission of Illuminating Gas," by E. H. Rix; "Something About Physics and Chemistry of Illuminating Gas," by F. C. Jones; "Utilization of Gas Engines in Connection with Long Distance Transmission," by John Martin; "Commercialism at Gas Association's Convention," by L. S. Bigelow; "Some Suggestion on Operation and Construction in the Electric Department," by G. C. Holberton; "Notes Regarding Gas Tar," by P. W. Prutzman; "The Public Corporation and the Municipality," by H. C. Brown; "Some Economics in High Pressure Gas Transmission," by E. H. Rix; "The Story of the Restoration of the Gas Supply in San Francisco After the Fire," by E. C. Jones; "How Electricity was Served to Consumers and Street Car Lines by the San Francisco Gas & Electric Company After the Fire," by L. E. Reynolds; "The Equity of the Sliding Scale," by F. H. Leach, Jr.; "Experiences with High Pressure Gas Mains," by Sherwood Grove; "Art of Canvassing," by John Clement; "Experiences with a Small Municipal Gas Plant," by C. E. Moore; "Large Gas Engines for Power Purposes," by J. E. Ane; "Gas Sales," by S. P. Hamilton.

PUBLICATIONS RECEIVED.

"Graphite" for April, 1907, from the Joseph Dixon Crucible Company of Jersey City, besides the usual interesting descriptions of graphite and its applications, contains the second installment on "Feeding Graphite for Lubricating Purposes," by W. H. Wakeman. There is also valuable information for automobile owners.

The Monthly Bulletin for April, published by the Ohio Brass Company of Mansfield, Ohio, contains an interesting article on "Catenary Construction on the Fort Wayne and Springfield Single-Phase Railway."

CATALOGUES RECEIVED.

The Fort Wayne Electric Works, of Fort Wayne, Indiana, send Bulletins No. 1086, Direct-current Series Enclosed Arc Lamps Differential Type Form C.; No. 1091, Direct-current Motors, Type EF, No. 1092, Type S Single-phase Motors, and No. 1093, Small-power Motors—Types GA and GD. These illustrated descriptions contain valuable information on each type of apparatus.

TRADE CATALOGUES.

Bulletin No. 1421 of the Allis-Chalmers Company, Milwaukee, Wis., illustrates and describes the Overstrom table for concentrating ores.

PERSONAL.

A. B. Vandercook, formerly in charge of Los Angeles branch of the Telephone and Electric Equipment Company, has succeeded R. L. Phelps as manager of the sales department of this company, with offices in the Union Trust building, San Francisco.

John D. Boyd of the Palo Alto municipal lighting plant was in San Francisco during the past week.

B. C. Holst, representing the California Electric Works in Nevada, is visiting the San Francisco headquarters.

INDUSTRIAL

A LESSON IN ECONOMY FROM NEW SAN FRANCISCO.

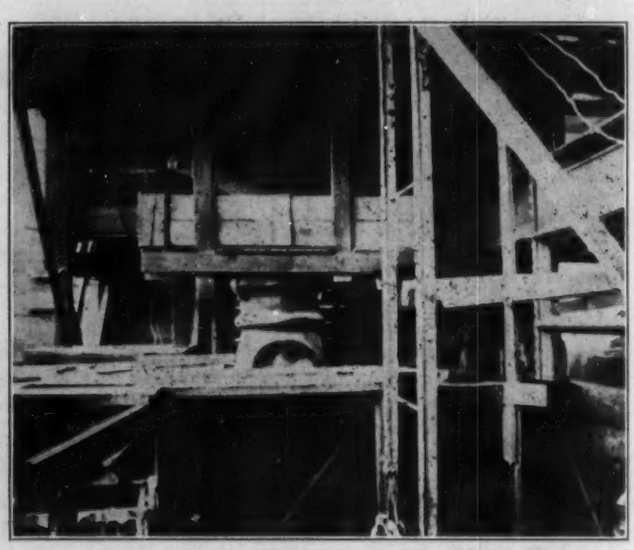
In the rebuilding of San Francisco, methods of economical leveling and construction have been sought out and practiced to a greater degree, probably, than at any other time and place in the world's history. As an instance typical of this, we may cite the work done on the Crocker building, standing at the corner of Post and Market streets, where

every avenue to waste, both of material and labor, has been most successfully closed through the exercise of a little ingenuity and forethought, aided by the best of modern crushing machinery.

This structure, which is ten stories in height, with a frontage of about 200 feet, escaped any serious damage from the earthquake, but was gutted by fire.

The frame of the building being intact, nothing more was necessary than a reconstruction of its interior, and the contractors at once hit upon the profitable plan of utilizing for concrete mixture all bricks, tiling, stone work and flooring which had to be removed. Suitable apparatus was therefore installed, and, as fast as the work of tearing down made this material available, it went directly to an Allis-Chalmers "Gates" Breaker, fed from bins supplied by chutes from various sections of the building. After being crushed to the desired fineness, the product of the breaker passed to a mixer, and as the concrete material issued from the latter, it was taken by a system of elevators and conveyors to all parts of the building where needed.

The significant feature of this process lies in the fact that, from the moment the material was taken from the walls and floors until the time it again became a part of the structure, there was not the slightest break or loss in its



handling. Of chief importance in this outfit is the breaker installed by Allis-Chalmers Company for the Roebling Construction Company, who state that they are very much pleased with the results obtained from it.

SHAWMUT POCKET TEST LAMP.

The accompanying illustration shows the Shawmut Pocket Test Lamp, a new device which the Chase-Shawmut Company has just put upon the market. The difficulty and annoyance which has occurred from defective indicators of enclosed fuses in general, necessitating the employment of cuit.

cumbersome methods to determine blown fuses, led the Chase-Shawmut Company to design a test lamp to be used as a short-cut method of discovering same. It is also useful to show whether or not a circuit is alive.

It is made up of a specially-designed incandescent lamp enclosed in a fibre casing. This casing has ferrules and knurled binding posts on either end, while at the middle a

fair-sized hole through both walls of the casing allows the illumination of the lamp to be plainly seen. For the majority of switches and fuses the metal ends of the test lamp will bridge the parts of opposite polarity, but for work where the distance is greater than the length of the test lamp the binding posts afford a convenient means of clamping leads of sufficient length. It is not designed for continuous service and should be used only for flashing, as the small enclosed casing will soon become too hot if left long in circuit.

THE WESTON MULTIMETER, MODEL 58.

The Weston multimeter is a new form of electrical measuring instrument which possesses a very wide range of usefulness in the measurement of electrical quantities. It will serve the purposes of a direct-current voltmeter, milli-voltmeter, ammeter, mil-ammeter, ohmmeter, ground detector and wheatstone bridge.

When used as a voltmeter, milli-voltmeter, ammeter or mil-ammeter, it is nearly equal in accuracy to any of the separate Weston portable direct-current instruments bearing those names and having substantially the same ranges. It differs from the regular forms in that a special movable coil is employed; which adapts it to better meet the several requirements of the combination of which the indicating instrument forms a part. The scope of measurements which may be made with the multimeter is large. It consists of a Weston type wheatstone bridge, a battery of twelve silver chloride cells, and an indicating instrument with detachable shunts.

The calibrated scale of the instrument has 160 divisions, with the zero (0) placed at 10 divisions from the end so that when the instrument is used as a galvanometer in connection with the bridge, both positive and negative deflections may be observed. The shunts are fastened in a compact form to a single base. They have binding screws, and can easily be connected to the instrument by flexible cables about six feet in length furnished with the instrument for that purpose. The shunts are constructed of Weston patent alloy having a negligible temperature co-efficient, so that the combination of instrument and shunt is practically free from errors due to changes in temperature.

The wheatstone bridge, which forms a part of the multimeter, consists of a rheostat with three groups of coils, adjusted respectively to units, tens and hundreds, aggregating 999 ohms, and a set of five ratio coils. Many novel features are embodied in its construction, and its design is such that compactness and durability are combined with convenience of arrangement, and an exceptionally high insulation resistance. All conductors and plug receptacles are placed under, instead of upon, the rubber top. This form of construction prevents any reduction in the insulation resistance, as the under side of the rubber plate is not exposed to the deteriorating effects of light, dirt and moisture.

The large area of conductors employed, their compact arrangement and the absence of all temporary or imperfect connection, together with the perfect fit of the five plugs, which are all that are required, make the "zero" resistance of the instrument less than that of any other portable bridge manufactured.

A push button is the only visible part of the double successive contact key, by means of which the galvanometer and battery circuits are made and broken.

A separate compartment in the case is provided for the battery, which consists of twelve cells connected together in series and fastened to a hard rubber top. A single cell may be used, or several in series. Any cell may easily be removed in case of necessity. Exhausted cells should be taken out, and if not replaced by others. the terminals to which they are connected sh ould be short-circuited. Further particulars will be sent by the Weston Electrical Instrument Company of Newark, N. J.

THE STRAWBERRY VALLEY TUNNEL PROJECT.

Some of the most interesting engineering work is being prosecuted in connection with the Reclamation Service of the United States Coast & Geological Survey. One of the more recent of these undertakings has been inaugurated near Vernal, Utah, known as the Strawberry Valley Project.

This project includes the irrigation of several thousand acres of productive soil in the southern part of Utah County. A storage dam, having a capacity of about 100,000 acre feet, and reaching a height of forty-five feet, will be thrown across the Strawberry River. Water from this reservoir will be led through a tunnel more than three and one-half miles long to the distributing points, where it will be diverted into canals for irrigating the various ranches.

The construction of this dam will make possible the electrical development of a considerable water power, and a power house having a capacity of 2,250 kilowatts is contemplated. The power will be used not only for lighting various surrounding small towns, but for motor-driven centrifugal irrigating pumps.

A temporary power house will be erected at once at Spanish Fork, some thirty-three miles from the construction camp, so that electricity will be available for building operations. The electrical equipment will form the nucleus of the plant, which will eventually be installed on the Strawberry River.

The electrical equipment for this temporary power plant will be furnished by the General Electric Company. The initial apparatus, including two 425-kilowatt, three-phase alternating-current generators, direct connected to Leffel water wheels. The generators will furnish current at a potential of 11,000 volts to step-up transformers, which in turn will raise the voltage to 22,000 for transmission. Two belt-driven, 45-kilowatt generators will supply direct current at a potential of 125 volts for excitation purposes. Switchboard equipment will be provided for both the main station and two sub-stations.

At the sub-stations motor-generator sets will be installed for supplying direct current for hoisting motors and other purposes. The motor-generator sets consist of 75-kilowatt and 50-kilowatt direct-current machines, each direct connected respectively to a 157-horsepower and a 125-horsepower 2,080-volt induction motor. The shafts on the induction motors are extended to take pulleys from which air compressors are belt driven. The compressed air is used for driving rock drills. On account of the double duty which they perform, the induction motors are of the comparatively large capacity indicated.

Work on the tunnel has already started, but will be greatly facilitated when the temporary power house is completed, since the operations, up to the present, have been handicapped by the employment of small gasoline engines for power.

Following the defeat of municipal ownership at the recent election in Chicago, the Chicago City Railways Company has purchased of the General Electric Company, 1,200 direct-current railway motors with controlling apparatus for the operation of 300 new cars. Power for the new rolling stock will be supplied by additional electrical generating machinery aggregating 6,000 horsepower. Each car will be equipped with four 40-horsepower motors, this size of motor being the standard for urban railways.

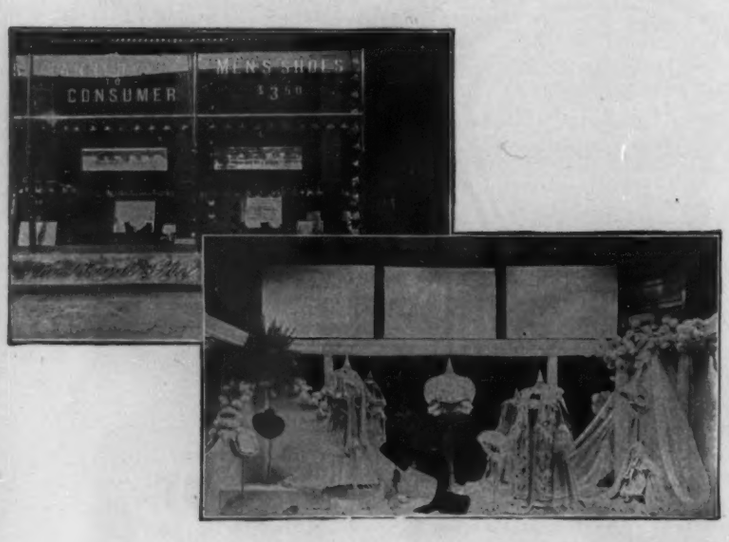
WINDOW LIGHTING.

This may be divided into two classes: (1) Where the lights themselves are the attraction. (2) Where lights are used to properly illuminate the goods displayed. In the first class come saloons and places where no goods are displayed, and the lights simply are used for attracting attention. Unfortunately, this method is often used where the result desired is to show the goods, as for example, where rows of bare incandescent and electric lamps form the border of a display window. Owing to their being in the line of vision, they fail lamentably in producing proper results.

A famous French scientist charges Americans with "caring as little for their eyes as they do for their stomachs." That there is a measure of truth in this statement cannot be denied.

People looking in the window often make the statement that the light is "hard on the eyes," which simply means that the source of light is too intense to be comfortably or safely looked at; this results in the loss of a large percentage of prospective customers.

The shrewd merchant has an eye for the comfort of every person that looks into his window. For a window where goods are shown, the light should be entirely hidden, and at the same time concentrated strongly on the goods displayed. When open flame illuminants furnished the only means of illuminating show windows, many a merchant said unto himself, "How can I set my goods so that the light will fall on them in the right way?" With the advent of electricity there came a change; the question the merchant asks himself now is, "How shall I place my lights so as to display my goods to the best advantage?"



The students of illumination were quick to seize upon this opportunity to display their ingenuity and have designed a reflector for use especially for window lighting. They can be used advantageously where the lights are placed either horizontally or vertically along the frames of the window. They have the advantage of not only concentrating the light strongly on the goods, but also protecting the eyes from the glare of the filament, thus allowing the use of clear lamps, where, if used bare, only frosted lamps would be permissible. At the same time, enough light passes through the prisms to make a pleasing appearance and add to the advertising value of the lights. Where it is desired to hide the lights entirely, they should be placed just above the top of the glass of the window. The reflectors will then concentrate the light and direct it downward, allowing just sufficient illumination for the ceiling. The reflectors can be slanted so as to illuminate a window of any depth or height. In case they are not placed higher than the top glass, a black band should be painted on the glass of sufficient depth to hide the reflectors from observation from the street.

A novel effect may be obtained by forming any desired sign in the black band, the light shining through the reflectors, making the letters stand out distinctly.

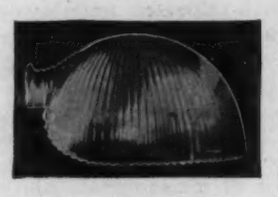


FIG. 1. SIDE VIEW.

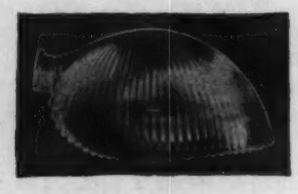


FIG. 2. SIDE VIEW.

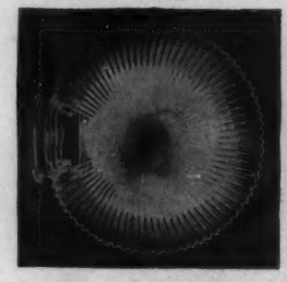


FIG 1. TOP VIEW.

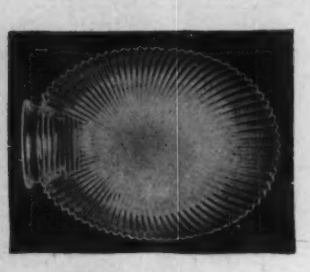


FIG. 2. TOP VIEW.

HOLOPHANE REFLECTORS FOR WINDOW LIGHTING.

In these days of strenuous competition, it is fast becoming evident that the most successful merchants are realizing that a window properly lighted is a strong selling factor that cannot be ignored.

Properly constructed reflectors are as essential to an enterprising merchant as a good advertisement in his local paper.

HYDRAULIC TURBINE AND GENERATOR AT NELSON, B. C.

A test run of an Allis-Chalmers Hydraulic Turbine Generator unit was recently conducted at the city power plant of Nelson, B. C. The turbine generator unit has a normal capacity of 750 kilowatts, but during the test run, this output was increased to 1,340 kilowatts for a period of over 45 minutes continuous running without undue increase in temperature of bearings. The usual tests were made as to the heating of the coils and bearings. According to the guarantee the armature and field coils did not rise in temperature above 35 degrees. The supply for light and power has been furnished up to the present time by the West Kootenay Power & Light Company, across the Kootenay River, from the new city power plant, out of which source both companies derive their power.

ELECTRICAL TRANSMISSION OF PHOTOGRAPHS.

The chief difficulty found in electrically transmitting photographic images has been the slowness of transmission and a want of distinctness, owing to the necessarily long exposure required by the fact that selenium loses more slowly than it acquires the conductivity due to the action of light. This has been partly overcome by employing a compensator consisting of two selenium cells, one of which receives directly the illumination of the photograph to be transmitted, while the other receives the light sent by a galvanometer intercalated in the electric circuit.

NEWS NOTES

TELEPHONES AND TELEGRAPHS.

Asotin, Wash.—The P. S. Telephone Company has commenced building a line to Vineland.

Tacoma, Wash.—Work has been commenced installing the telephone exchange in the court house.

Dexter, Ore.—The Dexter Tel. Co. has applied for a franchise to extend its lines from here to Springfield.

Oregon City, Ore.—The Clear Creek Mutual Telephone Company has purchased the Bonney line through Parkplace.

Marshfield, Ore.—The Pacific States Telephone Company will erect a new exchange building at corner of C and Second Streets.

Shell, Wyo.—The Shell Telephone Company, with a capital of $1,500, has been incorporated. A line will be built to Greybull.

Waitsburg, Wash.—The Pacific States Tel. Co. has leased the plant and system of the Waitsburg Rural Tel. Co. for a term of ten years.

Calgary, Alta.—The Council has voted in favor of installing a municipal telephone system. About 4,000 telephones will be required.

Spokane, Wash.—Contract has been awarded to Fife & Connor for $20,000 for blasting and stone work for ditches for the Home Tel. Co.

Portland, Ore.—Work has been commenced on improvements to the Pacific States Telephone & Telegraph Company, to cost $1,500,000.

Missoula, Mont.—The People's Telephone Company, capital $10,000, has been incorporated by F. M. Taylor, R. D. Prescott, J. A. Moss and W. R. Hamilton.

Tacoma, Wash.—The Home Tel. Co. will erect a one-story brick sub-station at once to cost $15,000, at South 45th and L Streets; plans by Russell & Babcock.

Livingston, Mont.—The Shields River Telephone Company is planning to construct branch lines from Clyde Park to Cottonwood and Horse Creek and establishing a toll line from Myersburg to this place.

Eureka, Cal.—Attorney L. F. Puter of this city states that he represents capitalists who will establish an independent telephone system here, with long distance connection to San Francisco, Redding and the East.

Eugene, Ore.—The Creswell and Cloverdale line, the Camas-Swale line and the Howe telephone line have been consolidated by L. A. Newton, of the Pacific Telephone Company, and will be connected with the Eugene system.

Farmington, Mont.—The Farmington Co-operative Telephone Company has been incorporated with a capital of $6,000 by H. R. Thompson, R. H. Wright and Ben Bolland. The company will build lines to Chateau, Collins and Conrad.

Clarence H. Mackay, president of the Postal Telegraph Company, has announced that his company will shortly commence the construction of a new route beginning at Salt Lake and ending at San Francisco. At a point midway, probably at Reno, a connecting line will be run south in the heart of Nevada, touching Goldfield, Tonopah, Manhattan, Rhyolite, Beatty and other towns to a point on the main line of the Santa Fe. The estimated cost is about $1,000,000, and the length of the line will be from 1000 to 1200 miles. President Mackay has been making a hurried trip of inspection of the Postal lines in California, Nevada and Utah.

San Francisco, Cal.—E. C. Bradley, assistant to the president of the Bell Telephone Company of Boston, whose stockholders are largely interested in the Pacific States Company, has arrived here from the East, and intends to stay for some time. It is known that he has come to the Coast to render what service he can to the local 'phone company during the progress of the graft investigation. He is familiar with conditions in San Francisco, as he planned the reconstruction of the local system after the fire of last April.

San Francisco, Cal.—The Southern Pacific Company is preparing to spend hundreds of thousands of dollars in the establishment of new copper-wire telegraph lines and the establishment of several supplementary galvanized-iron wire lines, all demanded by the greatly increasing volume of business and the growth of the country served by the railroad. A solid copper wire is to be strung from San Francisco to Ogden, supplementing the two already connecting those two points. Another solid-copper wire is to be stretched from here to Ashland, Ore., and there connected with the Oregon Shore Line, copper wire stretching on to Portland A new copper wire is to be strung from San Francisco to Los Angeles for local business, to relieve the immense strain now put upon the through copper wire from San Francisco to El Paso In addition to these expensive lines, the company is about to string new galvanized iron wires from San Francisco to San Luis Obispo, from Sacramento to Red Bluff, and from Nogales to Guaymas, in Mexico. The copper wires are well adapted to "quad" service, with two operators working on each end at the same time, sending four messages over the one line simultaneously. In conjunction with this extensive improvement the Southern Pacific is installing a private telephone exchange in the Flood Building here, where seven operators will be kept busy. This, it is said, will be the largest private exchange in the West.

INCORPORATIONS.

Los Angeles, Cal.—The American Crude Oil Company has been incorporated here with a capital stock of $500,000. Those behind the enterprise are J. M. Danziger, W. F. West and D. C. Wallace.

San Bernardino, Cal.—Articles of incorporation have been filed by the Rialto Land and Water Company, which place the capital stock at $100,000. Those financing the company are A. A. Leighley and E. W. Lawrence of Los Angeles and G. H. Peters of Rialto.

Wonder, Nevada.—The Wonder Water Company, incorporated in California under the management of E. S. Cunningham, delivered water in the town of Wonder, May 1, 1907. The company has absolute water rights to Bench Creek springs, in the Alpine mountains, six and one-half miles from Wonder, and will deliver water to all parts of the town at two cents per gallon, eight cents less than the previous cost. W. A. Stevens of San Francisco is president and manager, W. A. Starr, vice-president and secretary, and J. T. Overbury of Rhyolite, A. P. Eisen of Goldfield and Roger Chickering of San Francisco the board of directors. Stevens, Chickering, Cunningham and Starr will run an ice plant in connection with the waterworks. Mr. Cunningham will have the supervision of the construction of the plant, on which work will be rushed as soon as the machinery can be delivered.

POWER AND LIGHT.

Waistburg, Wash.—Roberts & Henderson are planning to enlarge their electric light plant.

Moscow, Ida.—The Idaho-Washington Light & Power Co. has been incorporated with a capital of $500,000.

Battleford, Sask.—Bids will be received by O. C. Lourie, secretary, until May 10 for installing an electric lighting system.

Port Orchard, Wash.—The Port Orchard Electric Power Company, capital $100,000, has been incorporated by Adah M. Eubanks and Alfred S. Eubanks.

Basin, Wyo.—The Basin Electric Light & Power Co. is contemplating the installation of additional boiler of 85 horsepower. F. E. Frisby, manager.

Oroville, Wash.—Two carloads of machinery have arrived for the Oroville electric plant that is being erected on the Smilkamen, four miles above town.

Everett, Wash.—Eastern capitalists, represented by Emery, Romke & Denny, are planning to erect a large power plant near Sultan at a cost of $150,000.

Aberdeen, Wash.—The Grays Harbor Electric Railway and Lighting Company will erect a central power plant between here and Hoquiam at a cost of $300,000.

Grangeville, Ida.—The Big Baldy Mining and Milling Company will erect a large power plant on Crooked creek, power to be used in developing mines in Buffalo Hump district.

Baker City, Ore.—The People's Light and Power Company, capital $250,000, has been incorporated by Ray Nye of Fremont, Neb., and John Thomsen and Isador Fuchs of this place.

San Francisco, Cal.—The Board of Supervisors has passed an ordinance ordering the erection of 14 electric light arches at street crossings on Fillmore street, between Fulton and Sacramento.

Corona, Cal.—The City Trustees have signed a contract with the Corona Electric Company whereby ten arc lights of 2000 candlepower and 160 incandescents of 32 candlepower are to be furnished for $2500 a year.

Mountainhome, Ida.—The Mountainhome Electric Company will enlarge its plant at once, and has awarded contract to the Spangenberg Electric & Machine Company for a 75-kilowatt, three-phase, 60-cycle, 220-volt, rotating-field generator; also a modern marble switchboard.

Cordelia, Cal.—E. D. N. Lehe, the well-known electric light and power promoter of Dixon, who operates all the electric plants of the smaller towns in the Sacramento Valley section, has decided to run a line into Cordelia for the purpose of supplying lights and power here.

Yerrington, Nev.—F. J. Baum and R. F. Maynard came in from Carson City by way of Wellington the first of the week. They are looking over the field with a view to disposing of electric power from a plant which they expect soon to establish near the headwaters of the Carson River.

Wenatchee, Wash.—Electrical engineers in the employ of the Great Northern are preparing plans for replacing steam with electrical power in the Cascade tunnel. The plans include the construction of two power houses of 7,000 horsepower each at different points on the upper Wenatchee river.

Dixon, Cal.—E. D. N. Lehe and F. R. Orella have purchased the Rio Vista Electric Light and Power plant and are making arrangements to extend a power line from here to that town immediately. They will furnish light and power there for the whole twenty-four hours, double the time granted by the old company.

Seattle, Wash.—The City Lighting Company of Seattle has been granted a franchise for owning and operating a gas plant in West Seattle with the proviso that gas shall be charged for at a rate of $1.25 per thousand, with a rebate of 25 cents per thousand if bills are paid before the 10th of the month. The company has been given thirty days to consider acceptance.

Seattle, Wash.—The capacity of the city lighting plant is to be doubled and bids are being received for two 8,000 horsepower turbines; two 4,000 kilowatt, 2,300 volt, 60 cycle, three phase, revolving; nine 1,500 field alternating current generators; nine 1,500 kilowatt 2,300-3,500 volt transformers for the generating station and eight 5,400-2,500 volt transformers for the sub-station.

TRANSMISSION.

Napa, Cal.—In a special session held recently the Board of Supervisors granted a blanket permit to Henry Brown, the local banker, to construct power lines along the county roads in this county. Brown refuses to state for whom he is acting, otherwise than that he is to establish a competing power company.

Rhyolite, Nev.—The Rhyolite Heat, Power and Light Company has practically completed its power plant and the town is lighted by electricity for the first time. The plant is operated by large gasoline engines and is the only one in the State using this power. At first the company will not furnish power to the mines, but later on larger engines will be installed and many of the mines will use the electricity to run their hoisting works.

Forest, Cal.—An electric power plant is to be erected at the juncture of Wild Canyon and the North branch of Kanakab Creek, where 100 inches of water under 500 feet head and 50 inches of water with 300 feet fall may be had the year round. This power is to be utilized for the operation of air compressors for power drills, a forty-stamp quartz mill to which ore is to be trammed from the ledges, and electric lighting plant, power trams and sawmill plant. The work is to be done by an Eastern syndicate.

Oroville, Cal.—The problem of furnishing cement for the giant works of the Great Western Power Company at Island Bar has kept the engineers of that company busy for several months. The solution of the problem has been found in the old diggings of Cherokee. Sand from there has been tested and found to be of the grade necessary for the composition of the best Portland cement. Six months ago Veile, Cooper and Blackwell, consulting engineers for the Great Western Power Company, took time by the forelock and corralled all the loose cement they could find in California. They still require some 350,000 barrels and the sand for this can be obtained from Cherokee and hauled to Island Bar. It is planned to build an electric road between those places, a distance of six miles. Cherokee is having a livelier boom than ever since the old mining days.

WATERWORKS.

Redwood City, Cal.—The matter of purchasing a meter for the outlet from tanks and laying of pipe on Starabargh Street to the waterworks has been laid over until a later meeting of the Trustees.

San Jacinto, Cal.—At a special meeting held recently by the City Council a bid for the new pumping plant was accepted. Whether the old station will be repaired, a new plant erected on another site, or water obtained from another source, are questions to be answered at an early meeting of the Council.

Monrovia, Cal.—The City Trustees agreed last week upon electricity or gas as motive power, instead of steam, for the pumping plant to be installed at the city wells. The clerk was authorized to advertise the sale of $10,000 bonds for this purpose and $15,000 bonds for overhauling the present system of mains and making extensions.

Los Angeles, Cal.—The Long Beach Water Company is making extensive improvements in its wells north of Signal Hill by installing a complete electrical pumping apparatus. Eleven powerful motors will be put in at a cost of $10,000.

Alleghany, Cal.—Ground has been broken for a waterworks system which is to be installed and in operation by July 1st. The plant is being put in by H. J. Johnson, owner of the Tightmer Mine, but it is to be owned by the city. The plant will have a capacity of 23,000 gallons per day for domestic purposes.

San Francisco, Cal.—It has been decided that the city's auxiliary fire protection system shall be operated from the Twin Peaks reservoir, and that fresh water shall be used instead of salt water. The decision was reached on the recommendation of the Chief Engineer, who held that salt water disintegrated iron pipe in a few years. The fire stations on the bay will maintain and increase the pressure in case of big fires and the locations of the other stations have been settled. One will be at the foot of Twentieth street, near the Union Iron Works, one at the foot of Townsend street, and the third at the foot of Van Ness avenue. From these three stations a main skeleton of 20 and 18-inch mains will stretch over the streets, connecting at Market and Van Ness with the 18-inch mains from the hill reservoirs. On Twin Peaks, at 755 feet elevation, a 10,000,000-gallon reservoir will be built, which will be filled by pumping from wells in the Mission in the region of Howard and Twentieth streets. From this large reservoir two 18-inch mains will connect with a 600,000-gallon reservoir at an elevation of 440 feet, which will be in constant use, keeping the normal pressure on the mains. Practically all the streets in the heart of the city will have mains running through them, as the network is to be very extensive. Permanent connections will be made for the two fireboats on the water front.

TRANSPORTATION.

Los Angeles Cal.—Following the request of the Pacific Electric Company for a permit for the construction of a viaduct across Los Angeles street south of Sixth, the City Council has asked the City Attorney if such action would be legal. The question is as to the need of a railway franchise to cover the project.

Salt Lake, Utah.—An agreement has been reached between the Electrical Workers' Union and the Utah Light and Railway Company. The corporation granted the men an increase of 77 cents a day for foremen and 50 cents a day for linemen. The men asked that the foremen be given $5 a day and the linemen $4.50. They had been receiving $4 and $3.75, respectively. Former Congressman B. H. Roberts acted as mediator between the men and their employer.

Oakland, Cal.—General Manager Calvin of the Southern Pacific has announced that the company will soon have the narrow gauge line to the Alameda mole in complete running order as an electric line, and that it is proposed to have a fast electric train service on that road. All of the equipment has been ordered and is being moved forward as rapidly as possible. During the summer a large force of men will be kept at work making the changes necessary for the conversion from steam to electric power. One of the features to be introduced will be a fast electric train service between Oakland and Alameda, with the Oakland terminus at Fourteenth and Franklin.

Monterey, Cal.—Every mile of the 150 miles of the right of way of the Monterey, Fresno and Eastern Railroad Company has been obtained and construction work has been commenced on the line, which is to unite the San Joaquin Valley with the Bay of Monterey. By October 1 the road will be in operation between here and Hollister, a distance of 60 miles. This run will be through a district rich in agricultural products. The route of the line is from Monterey to Salinas, to San Juan, to Hollister, to Tres Pinos, to Cleveland, to Fresno. The total cost of construction and equipment will be $2,500,000, and the estimated earnings computed from a study of the conditions, will be $1,027,041.56 a year, sufficient to pay operating expenses, 5 per cent interest on $3,000,000, a 6 per cent dividend on the preferred stock amounting to $90,000, and leave an annual surplus of $170,816.32.

Sacramento, Cal.—A great deal of work is being planned by the Sacramento Electric, Gas and Railway Company for the coming summer. The street car lines are to be greatly improved. Work on the T street line will commence as soon as the material arrives from the East. The trolley poles for the line have already been put in place. The company intends also to improve the track of J, G and P streets. On J street the asphalt is to be torn up for about a foot on the inside of the rails and replaced by hard brick to prevent the street being torn up by the heavy wagon traffic passing over the rails. On G street, from Seventh to Nineteenth, the rails are to be torn up and replaced by heavier ones. The track will be ballasted with crushed rock, so as to put it in condition for many years' service without further improvement. The company is also erecting a $20,000 reinforced concrete building on N street for storing cars.

San Francisco, Cal.—The members of the Carmen's Union are out on strike, having voted last Sunday morning to leave their work because no agreement could be reached with the United Railroads. As a result the street car traffic of San Francisco has been entirely stopped, and the efforts made thus far to run cars through the streets have utterly failed. Mobs have attacked the cars, which were loaded with armed men hired by President Calhoun, and driven them to seek safety in the car barns, where large aggregations of ruffians are kept under arms by the railroad company. Promiscuous shooting by the strikebreakers has resulted in one death and a score of wounded citizens. The members of the union have assisted the police to the extent of their power in keeping order, but threaten to stop such efforts unless the reckless shooting by the hirelings of the company is discontinued. Militia and United States troops will be called out to quell the disorder if the police, with special aids authorized by the Mayor, are unable to cope with it.

FINANCIAL.

San Francisco, Cal.—Richard Hotaling, W. M. Rank and their associates have made a deal with a Baltimore syndicate by which a big electric railroad system is to be built in Marin, Sonoma, Napa and Lake counties, with ferryboat connection with this city. The proposed system will invade the territory of the Northwestern Pacific in Marin and Sonoma counties and that of the Southern Pacific in Sonoma and Napa counties. The undertaking involves the expenditure of between $10,000,000 and $15,000,000, and will include the purchase of the Petaluma and Santa Rosa electric road. Hotaling, Rank and their associates already have a terminal on Richardson's Bay, just across from Sausalito, and they have made surveys from it to San Rafael, thence to Novato and Napa, and thence to Lakeport. The proposed road will embrace an extension of the Petaluma line northward into the Healdsburg and Cloverdale country. Ultimately it will be extended into Lake County, thus forming a double line covering a great sweep of country between Lake and the Marin bay shore.

San Francisco, Cal.—A meeting of the committee appointed to represent the commercial and improvement organizations of the city was held and the question gone over thoroughly. Captain Payson was present and made a talk on the situation, telling of the difficulties which had met the Spring Valley Company in its efforts to supply San Francisco with water. He hinted that the grafters had made it hard for the company for refusing to come to terms. On being asked the terms on which the corporation would sell out to the city after ten years, according to the plan of the committee, he agreed to consult the directors and make a reply at the earliest possible moment.

San Francisco, Cal.—At a recent meeting of the Board of Supervisors a petition was presented from the City Real Estate Board asking that the resolution recently adopted revoking the franchise of the Spring Valley Water Company and declaring its properties escheated to the city be rescinded in order that the company might have a chance to rehabilitate its plant. The question was referred to the Public Utilities Committee.

San Francisco, Cal.—It is asserted by the local papers that a syndicate of New York and San Francisco capitalists will within the next few weeks make an application to the Board of Supervisors of San Francisco for a franchise for a system of electric street railways as a rival to the United Railroads. In the syndicate are Leopold Michels, the Myersteins and the Brandensteins of San Francisco and a coterie of New York millionaires represented by Leopold Wallach. The enterprise is being financed through the Knickerbocker Trust Company of New York and many millions of capital are represented. Agents of New York interests have been in San Francisco for several weeks and have completed a study of the streets and the engineering problems to be met in the proposed new system. Maps have been drawn and every detail arranged. The syndicate lacks only the franchise to make its plans complete. It is said that the plan includes a network of lines covering the whole city, and that part of the system will be run by overhead trolley and part by conduits. The scheme had been proposed before the fire, then temporarily abandoned, and again resumed on the report of the great traffic in this city which the United Railroads are unable to handle.

FOR GAS COMPRESSORS see RIX C. A. & D. Co., S.F.

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Pierson Roeding & Co.

Annunciators
California Electrical Works.
Century-Klein Electric Co.
Holtzer-Cabot Elec. Co.
Patrick, Carter & Wilkins Co.
Tel. and Elec. Equipment Co.

Asbestos Products
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Automatic Sprinklers
Pacific Fire Extinguisher Co.

Batteries, Primary
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Gould Storage Battery Co.
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Century-Klein Electric Co.
Gould Storage Battery Co.
Electric Storage Battery Co.
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Drawing Materials
Dietzgen Co., Eugene

Dynamos and Motors
Allis-Chalmers Co.
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Pacific Electric Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Engineering Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cutter Co., The
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore, Chas. C. Co., Inc.

Electric Watchman's Clocks
Pacific Fire Extinguisher Co.
Tel. and Elec. Equipment Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Ohmen Engine Works
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co.

Engines, Gas and Gasoline
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Century-Klein Co.
Copeland, Clem A.
Doble Co., Abner
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. P.
Smith, Emery & Co.